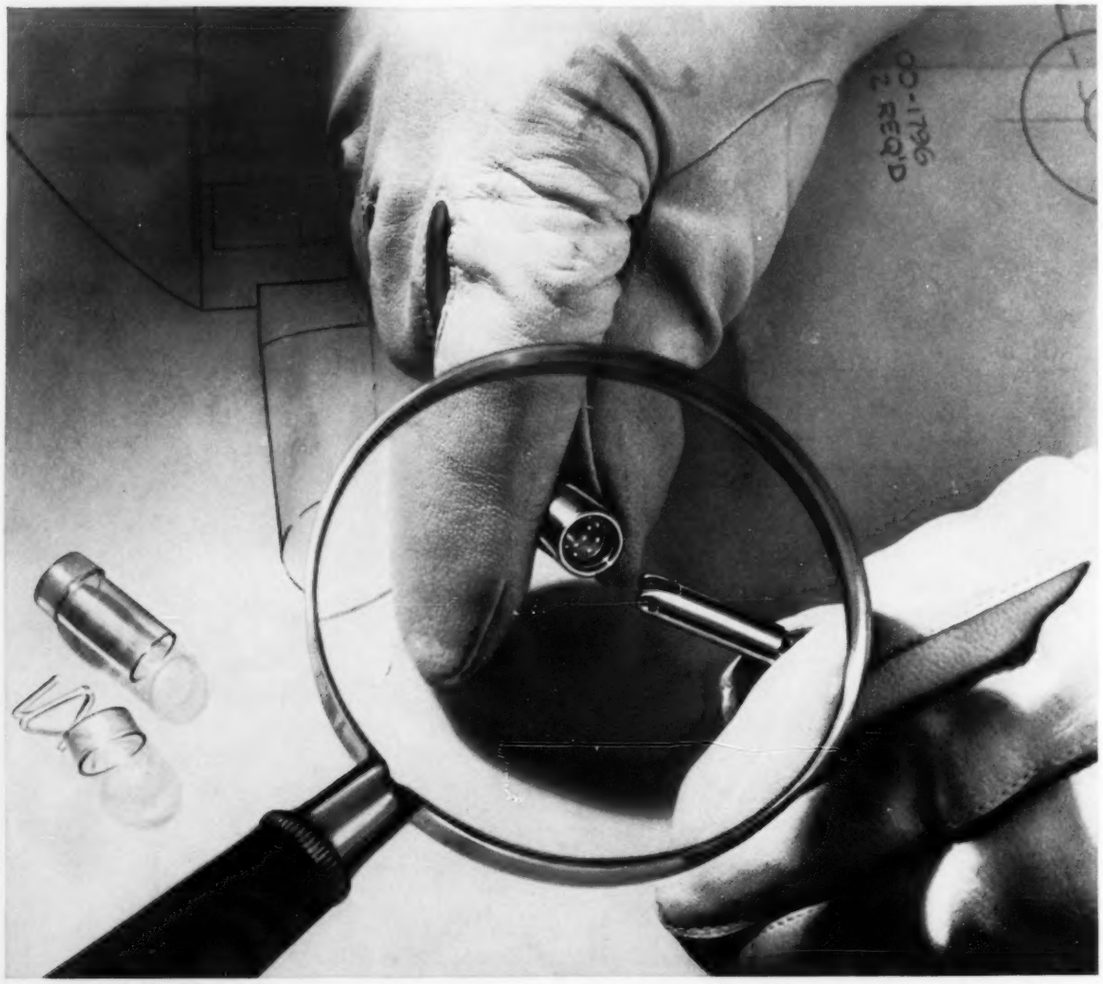
Design News

Hydrofoil craft stabilizing system. Page 76

A ROGERS PUBLICATION

FEBRUARY 27, 1961

NEW DEPARTURES IN MINIATURE



HOW TO GIVE ON-THE-NOSE GUIDANCE TO MODERN "FISH"

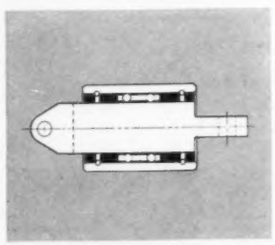
UNIQUE N/D LINEAR MOTION BEARING FREES GYRO CAGING ACTION

The bearing illustrated is an N/D linear motion precision instrument ball bearing. It was specially designed and built to help solve a critical problem in the guidance system of a high speed anti-submarine torpedo.

PROBLEM: Loss of accuracy in torpedo's guidance system due to hang-up of caging arm in gyro assembly.

SOLUTION: N/D Sales Engineer, in cooperation with manufacturer, found that *wear* of bushing on caging arm caused hang-up, delaying guidance activation. N/D Engineers set to work to design and build an instrument bearing that operates virtually friction-free. The result: Preservation of the guidance system's pin-point accuracy and reliability.

Should you require ball bearing design information, invite the local N/D Sales Engineer to participate in your early design discussions. He represents one of the industry's largest engineering staffs devoted exclusively to the design and development of miniature and instrument ball bearings. Or, write for new Miniature and Instrument Ball Bearing Catalog, Department L.S., New Departure, Division of General Motors Corporation, Bristol, Connecticut.



This special N/D linear motion instrument ball bearing increased guidance reliability of ASTOR torpedo weapon system developed by Westinghouse.

NEW DEPARTURE
MINIATURE AND INSTRUMENT BALL BEARINGS

Circle 1 on Reader-Service Card for more information

NBP February 27, 1961 BPA
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Worldwide Coverage of Technical

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DESIGN NEWS

News and Engineering Ideas. More than 48,000 copies every other Monday.

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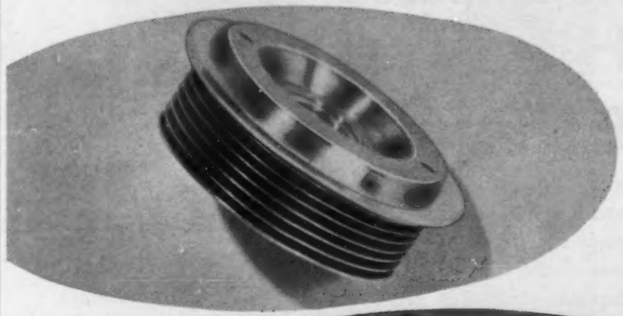
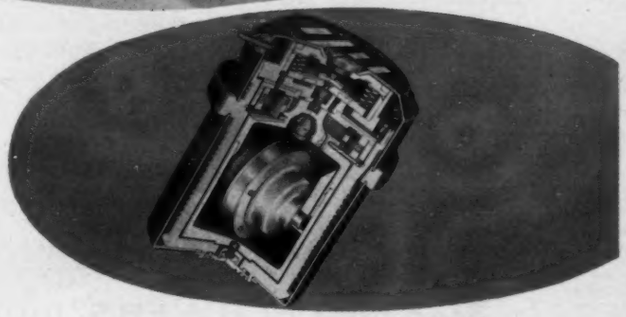
WELDED DIAPHRAGM BELLOWS
Engineered By

METAL Bellows

Selected by Minneapolis-Honeywell
For New Gas-Bearing Gyroscope





The complex new gas-bearing gyroscope shown here in a cut-away has a bell-shaped ceramic spin motor. Its interior spins at 24,000 revolutions per minute suspended on a film of helium gas only 25 millionths of an inch thick. The gyro weighs just 8 ounces, is 2.8" long and 2.0" in diameter.

Here is what the Welded Bellows Assembly Selected provides in this Minneapolis-Honeywell gyroscope:

1. Short nested length for long stroke and greater volumetric compensation.
2. Low spring rate resulting in minimum changes in pressure of the fill fluid over full temperature range.
3. Excellent spring characteristics eliminating the possibility of cavitation in fill fluid at the low temperature end.
4. Leak tightness.
5. Long bellows life and reliability.

Design and manufacturing services in full depth now available to West Coast customers from our Pacific Coast Division.

Ask for design data literature for volumetric compensating bellows.

METAL Bellows CORPORATION

102 MICA LANE, WELLESLEY HILLS 82, MASS.
Pacific Division: 20978 Knapp Street, Chatsworth, California

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HEAVY-DUTY BLOWERS...

M-D BLOWERS ARE BETTER THAN EVER! 12 new features have been added to make M-D blowers even more rugged and reliable and to guarantee positive oil-free flow under the most severe operating conditions. These improvements plus M-D's exclusive 3-lobe rotor design (which eliminates the possibility of rotor deflection at high speeds) permit operation at constant pressures up to 15 PSIG in single-stage and to 70 PSIG in multi-stage with capacities ranging from 30 to 4000 CFM.

SPECIFY M-D ROTARY POSITIVE BLOWERS FOR: Smallest Cube Dimensions • Widest Pressure Range • GUARANTEED Flow (Factory Tested). Oil-Free Air Flow

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M-D BLOWERS, Inc.
Racine, Wisconsin

M-D blowers can be mounted on any engine

A Subsidiary of MIEHLE-GOSS-DEXTER, INC.

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SOUNDING BOARD

FOR OUR READERS

A Rebuttal

Having read your editorial, " 'Dead End' Engineers", in the Nov. 24 issue of DESIGN NEWS, I feel compelled to offer a rebuttal. My comments are based on personal opinion, coupled with observation and experience. They are probably derived in much the same manner you used in developing the philosophy which prompted the editorial.

However, it seems to me that it is compounded on a fallacy—the erroneous assumption that engineers have to be organized. You say that an apathetic attitude has defeated professionalism, and then you indicate that unionism is the only alternative. I concur with you that there is a valid argument for professionalism, but I fail to see any case for unionism. Your thesis that any organization is better than none is not necessarily a truism. . . .

FREDERICK J. REX, JR.
North Reading, Mass.

'Dead End' Engineers

Your editorial entitled, " 'Dead End' Engineers", (page 3, Nov. 21, 1960, issue of DESIGN NEWS) reflects an attitude that is prevalent in our country today and, unfortunately, tends to undermine the spirit of individualism which has contributed so very much to the advances in engineering so readily evidenced all around us.

Most of the flag-waving for a strong engineering association today can be attributed to your "dead end" engineers, who can see no other way to achieve the recognition attained by their more talented or ambitious brothers who have made a mark in the engineering field.

There are no set rules or qualifications by which a man can be judged to be an "acceptable" engineer. In engineering, the rule for the day is uncanny creativity tempered with sensible practicality, a combination which demands the utmost of an engineer's talent and initiative to do a good job. He must be imaginative, yet conforming—impulsive, yet restrained. In this respect, engineering becomes more of an art than a profession, and no self-respecting artist will advocate the formation of an association which tends to contaminate the art with the influence and company of "also-rans".

Basically, then, the field of engineering characteristically does not lend itself to the formation of a strong association which would embrace all branches of engineering. This fact should not be viewed with alarm, however; the field will still retain its present prestige through engineers who have made engineering a profession through the fruits of their work rather than the crutch of an association.

EDWARD J. STADLER
Flint, Mich.

Too Broad

I read your editorial, " 'Dead End' Engineers", (Nov. 21, 1960, DESIGN NEWS) with real interest. Personally, I wonder if there is such a grouping of humans which can be titled "Engineers". Perhaps the category is too broad to achieve any kind of collective harmony.

Is not an engineer a person who thinks in certain logical steps and expresses his thoughts in a certain type of mathematical language? What else is he? Could not cooking be approached in this fashion? Or farming?

The medical profession has many internal groupings who violently disagree, but they have one overriding purpose with which they are all in harmony: "The preservation and improvement of human health". The legal profession is the same with the "preservation and protection of the law". But what is the single harmonious purpose of the engineering profession?

When we group all engineers together under one association we make the same mistake that is made when we say that all people of the same ethnic origin have the same basic characteristics. It just isn't so.

It isn't that "engineering is a dead end". It is that engineering just isn't an end at all! It is like a language!

H. B. LYON
Ordnance Research Dept.
Lockheed Missile & Space Div.

• **Could be. E.R.C.**

Clarification Needed

We have read and reread your editorial, " 'Dead End' Engineers", agreeing with the greater portion of what you have written.

Your statement that professional registration in most states is a farce has me puzzled. Do you mean that the qualifications are a farce or that the social status of registration is a farce? I, for one, would appreciate a clarification of this point.

• **Both. E.R.C.**

We are currently conducting a program to recruit members to "our" branch of the professional engineering society. Could you give us the cost of two dozen copies of your editorial to help us in our efforts to get a few engineers off bottom dead center?

JOHN R. VANDERVOORT
Transmission Div.
Fuller Mfg. Co.

• **Sent. E.R.C.**

DESIGN VIEWS

Process of Progress

For every project or engineering design problem, there are many different ways of approaching the same end result. How then does one determine which way is best?

Often even our best intuitive reasoning will not reduce the number of possible alternatives to less than two or three. Many solutions may appear equally attractive or promising.

Successful men who get things done have learned that it is better to select a course of action and follow through until problems or obstacles present themselves in concrete form. Many of the obstacles vanish in the process.

It is easy to think of many reasons why any new idea will not work. As engineers, we tend to think of the negatives. But, remember, it takes only one valid solution to render void a'l the negatives of any situation. The basic requirement for success is to find that one solution.

Most progress in design engineering occurs in steps or plateaus. Seldom does steady advancement toward a design solution occur. You work and live with a problem for several hours, days, weeks or sometimes months, and then suddenly, while shaving one morning, you have the right idea or thought and you are off to a new plateau. You find new problems on this level also, and the process of thinking and calculating begins all over again.

Quite casually, sometimes as if by accident, the right idea, thought or solution presents itself "in your mind's eye" and you can take another step up the ladder of progress.

Organized research and development is really nothing more than the separation of a complex problem into its component problems whereby each particular portion becomes a man-sized task that an individual can solve.

In my opinion, there is no basis to the theory that team research is replacing the individual in today's industrial developments. All that research organizations have done is to harness the collective efforts of many individuals into a coordinated team effort directed toward solving some of the more complex problems. And even then sometimes the key solution or idea comes from an outside viewpoint.

The human mind has capabilities that will never be duplicated or replaced by electronic brains. Nor will the complete integration of a team effort ever occur in research and development.

The process of progress is an individual thing. It is sometimes a lonely, unpopular or even emotional course, but at the end is true satisfaction for those with determination and energy to progress.

Ernest R. Cunningham

Editor

NEW MASSIVE MC NYLON PLATE NOW AVAILABLE!

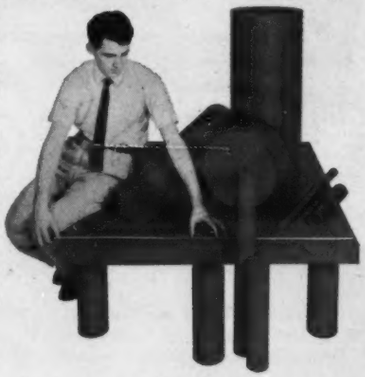
• Huge MC Nylon plate—the largest ever produced—is now available for wear plates, panels, tooling, fixtures and other applications which need nylon's unique mechanical or structural properties.

Polymer's exclusive revolutionary new processing techniques make production of large plate practical with price reductions of 15% under nylon plate presently available. Standard stock availabilities now include thicknesses from ½" up to 4" and in 2' by 4' sections. Availabilities to date were limited to 1½" maximum thickness in 10" widths. MC Nylon now opens new design possibilities and manufacturing economies. On special order plates of over 6" thickness in sections of 4 foot widths and 10 foot lengths can be supplied.

In tubular bars, the specially formulated bearing material now costs less than continuous cast bronze bushings of similar size, with prices up to 50% below other nylons.

MC Nylon tubular bars are made in OD's from 2" to 15" with wall thicknesses of ⅜", ½", ¾" and 1". Rod up to 17" diameter is also available with special larger sizes and shapes made to order. Supplied in Polypenco blue.

Call or write for full information.



POLYPENCO *industrial plastics*

The Polymer Corporation of Pennsylvania
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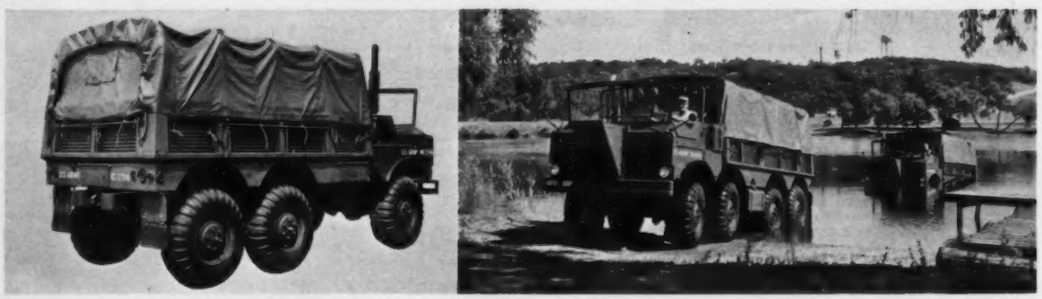
Welded Aluminum Body and Cab Provide Tactical Truck Flotation

Robert L. Candlish, Detroit Editor

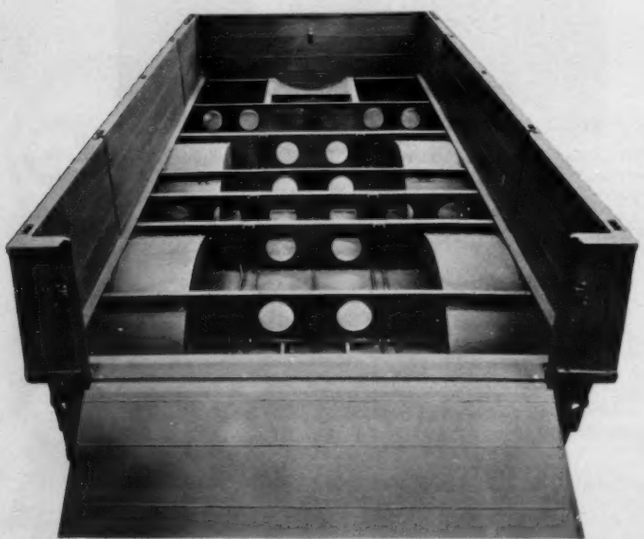
PONTIAC, MICH.—One-piece, welded-construction cargo bodies and cabs for a new family of Medium-Duty Tactical Vehicles are lightweight and watertight. This provides a high degree of buoyancy without use of flotation material that might interfere with body repairs or maintenance.

Body and cab are repairable by welding. Aluminum extrusions are used extensively in both units. Body is fixed to frame at rear and is rubber-mounted at front. Cab is three-point mounted to eliminate transfer of frame torsional movements.

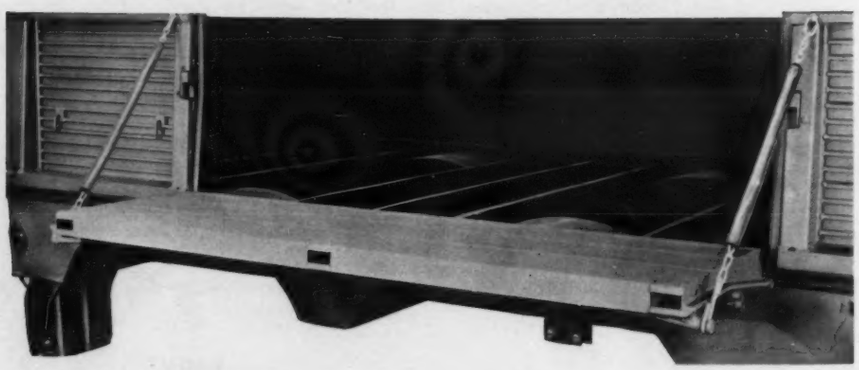
The Medium Duty Tactical Vehicles are produced by GMC Truck & Coach Div.



MEDIUM-DUTY TACTICAL VEHICLES provide transport for troops and cargo over difficult terrain and through water. Six-wheel drive vehicle has 3½-ton load capacity. Cargo box volume is 180 cu ft. It will seat 14 men. Eight-wheel vehicle has 5-ton load capacity, cargo box volume is 205 cu ft and it will seat 16 men. Propulsion afloat is by rotation of wheels; steering is conventional by front wheel position.



ALL-WELDED BODY has extruded aluminum cargo floor with three tool storage areas underneath. Driver-operated, air-controlled water drain valves are located in bottom corners.



THREE CARGO DOORS, one at rear and one at each side of body, permit palletized loading. Central control handle operates latches, securing door gates. Rubber door hinges are part of watertight seal.

Low-Frequency Signals on Movie Sound Track Actuate Slide Projector

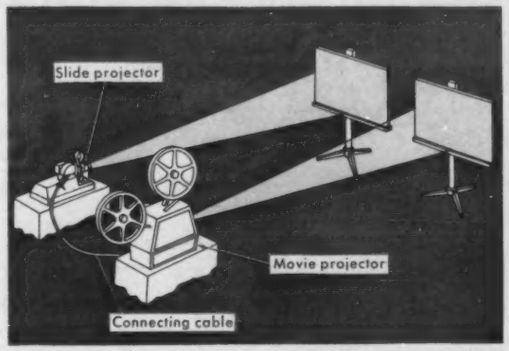
Lars G. Soderholm, Midwest Editor

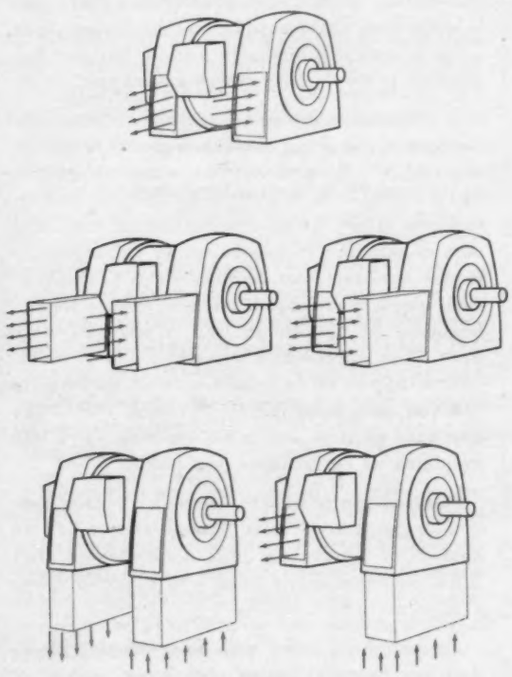
CHICAGO, ILL.—A method of simultaneously showing and coordinating sound motion pictures and slide films uses inaudible 30- to 50-cycle tone signals from the movie sound track. Signals synchronize slide projector operation with the movie.

In this type of dual operation, both the movie and slide picture are shown side by side. By proper timing, still-pictures of charts, graphs, photos, maps or any other material not requiring animation can be projected and explained through the accompanying movie.

The design problem involved the synchronizing of both projectors in a manner not objectionable or distracting to the viewer. A sub-audible tone signal is cut in the sound track of the motion picture film at the point where a new slide frame is wanted. The audio-amplifier of the motion picture projector then is connected to the open end of the electrically activated advancing mechanism of a slide film projector. Low-frequency pulses from the sound track are enough to trigger the advance mechanism of the slide projector and bring up a new frame of the slide film strip.

The Duo-Pic method of presentation was developed by Carter and Galantin Corp., a division of Dorsett Electronics Laboratories, Inc.



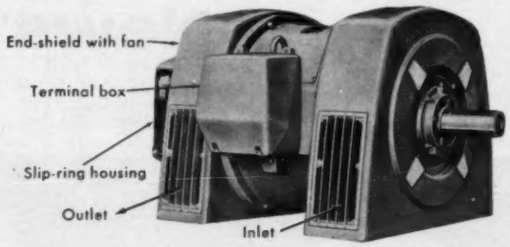


Motor Redesign Achieves Functional Shape

Volrath Holmboe, Correspondent in Sweden

VAESTERAAS, SWEDEN—Amply dimensioned end shields serve as combined bearing housings and supports, and form a stable base which makes a redesigned induction motor relatively free of vibrations. Together with the intermediate cylindrical part, the arrangement provides a cleaner and more attractive shape than the original design with central support.

A large-diameter fan fitted into one of the end shields provides efficient cooling. It also separates the slip-ring housing from the motor itself in order to protect windings against dust from the brushes. Some of the cooling air is passed through the slip ring housing on the way out. Vertical grids in the front of the two end shields serve as air inlet and outlet. Rectangular channels may be attached easily to the nearly flat grids in order to duct the air. Alternatively, grids may be closed and the air may be passed vertically in and out through the base.



Double diamond windings rather than conventional diamond windings are chosen for the stator in order to reduce the no-load current and thereby the no-load losses. Rotor windings are of the barrel type. Paper and cotton insultion have been replaced by synthetic polyester materials, such as "Mylar" and "Terylene", with higher dielectric and mechanical strength.

Output ranges from 150 to 1500 hp for voltages up to 6.6 kv. The motor, designated MAD, was designed and restyled by the firm ASEA.

Soluble-Oil Formulation Increases Rust-Resistance of Tin Plate

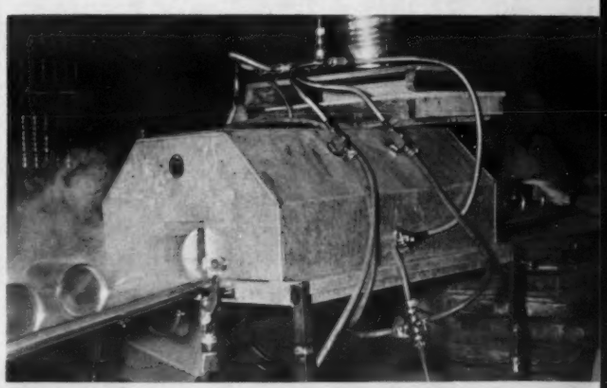
Edward W. Schrader, Western Editor

MENLO PARK, CALIF.—An emulsion of a soluble oil in water containing an inorganic corrosion inhibitor and a wetting agent increases the rust resistance of 0.25-lb tin plate to approximately that of 1.25-lb hot-dipped tin plate. Most favorable concentrations of the various components were found to be; 5 to 20 percent soluble oil, 0.5 to 2 percent sodium nitrate (inorganic corrosion inhibitor) and 0.25 to 5 percent Deriphat 151 or equivalent fatty amino acid derivative (surface active agent).

The formulation was developed by Stanford Research Institute as part of a research program dealing with sweat damage to canned goods shipped by sea from West Coast ports. Formulation is nontoxic.

Tests show the protective treatment to be quite effective under relatively light exposure conditions. As the severity of the exposure increases, the effectiveness starts to break down. In cases of severe condensation, measures to control humidity must supplement the protective treatment.

◆PROTOTYPE SPRAY MACHINE consists of sheet-metal hood equipped with 6 spray nozzles. Cans roll in single row through chamber.

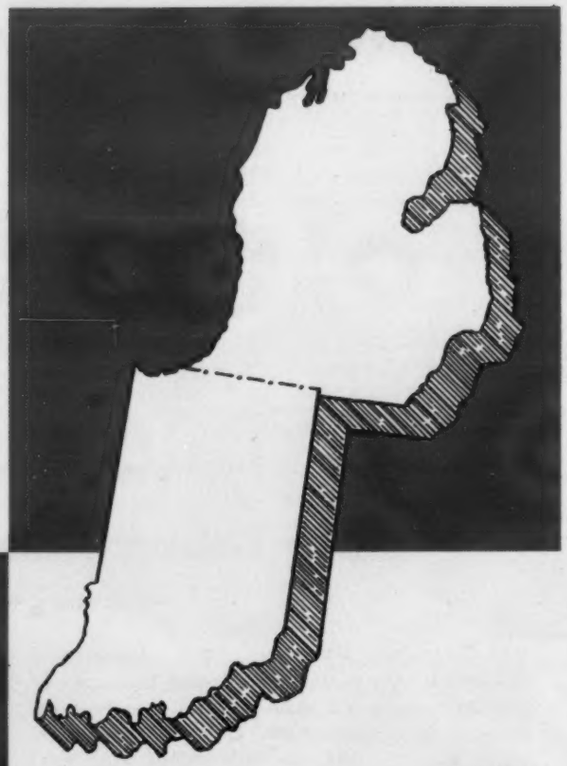


Bob Candlish

(B.S.—M.E., University of Michigan)

covers

- Michigan
  and
- Indiana



for Design News

Robert Candlish, Detroit Editor, obtains technical details for a feature article using his portable recorder. With the designer listening to check accuracy, this is one of the time-saving devices used by DESIGN NEWS Regional Editors in bringing you accurate field reports.

Bob insists on getting information for his articles first-hand all Design News Regional Editors do!

Bob is always on the move in search of new Design Ideas. It's his job to find them, to select pertinent facts, drawings and background material . . . then to report them accurately and concisely to you, the Design Reader.

Of course, many of his leads come by phone or letter from men like yourself. These he follows up in person.

Do you have an interesting Design Idea now past the preliminary design stage? If so, contact **Robert L. Candlish, Detroit Editor, Design News, 19600 W. McNichols Rd., Detroit 19, Mich., KEnwood 7-3740.**
He'll be glad to discuss a possible article with you.

Candlish inspecting cab-lifting mechanism on a GMC Tilt-cab truck in preparation for an article.

SEEN AND HEARD

SMOKE SCREEN OF SCIENCE

Robert L. Candlish, Detroit Editor

An acrobat once explained his preference for circus life by stating that he liked his associates there. None of them was a phoney. If a man claimed to be a lion tamer or a high-wire artist, he could be put to the test immediately. Both lions and high wires were available. In a matter of minutes the man could either be hired or buried. This direct approach certainly does have considerable merit.

On December 19, it was mentioned in this column that not all cars have good brakes, particularly when fade characteristics are considered. Fade is the tendency of brakes to become less and less effective as they get hot from frequent application.

In response to my earlier remarks, a letter was received advising that a brake-fade test is difficult to establish. "The problem here is heat dissipation, and it becomes quite a bit more complex both to test and specify acceptable standards. You need plots of interface (between moving and stationary friction surfaces), temperature as a function of time, speed, grade, pedal pressure, vehicle weight, frequency of application and a few secondary items. Then you compare this with a plot of coefficient of friction at the interface versus temperature and you have some meaningful data. I don't see any easy shortcut and hope we don't dive into standards of performance too hastily."

The message about not wanting a federal performance-standard comes through clearly but the balance of the quote is pure gobbledegook. This is beclouding a simple issue with a smoke screen of science.

To design a product may be a complex procedure but the proof testing, the simple "will it" or "won't it" work evaluation, is much more direct.

A brake fade test can be very simple. It requires only the following items:

1. The car concerned with brakes properly burnished-in and adjusted to manufacturer's specifications.
2. Ballast to load the car to full passenger, baggage and fuel load.
3. A winding road down a high mountain.
4. A hot summer day.
5. The test requirements are that the driver will maintain the legal rate of speed and will not

use downshift braking or make use of any previous knowledge of the road.

The question to be answered is: Will the brakes retain their usefulness all the way down the hill—yes or no! Can the car be slowed sufficiently for the last turn, or for that matter, can it get to the last turn? Once at the bottom, can a panic stop be made as might be required with a deer crossing the road? Only a few days' work is required to determine whether the product is ready to sell or if it's "back to the drawing board".

Naturally all auto makers evaluate their products in this manner. So why establish a standard? The fallacy is that they rate their own results. They could not with any conscience be as fanciful with brakes as they are in their horsepower ratings.

There are many conditions prompting the testers to pass their product, the most outstanding being that they have done their best within the limits established. Styling changes to the sheet metal or changes in wheel size to permit more cooling air to flow to the brakes most likely cannot be made. Corporate bookkeepers, being strongly aware that most cars are driven only to work or to the store and that few are taken down mountains, cannot be prevailed upon to let go of another penny for better components.

The facts remain that cars with brakes subject to fading have not been unknown and that volatile brake fluid that may be nothing short of a murder weapon is for sale in some areas for use everywhere. Fixed standards would determine whether or not car fade characteristics were intolerable and permit proper punishment of those persons peddling poor brake fluids.

It is also a fact that except for defective lights, the most common defect found on cars in safety checks is bad brakes, and this by a very low standard of performance. Granted, this deficiency is caused largely by poor maintenance, but if the product were better in the beginning, it would certainly last longer.

Almost every major industry, from meat packers to airplane builders, must operate to fixed standards of quality or performance. Their products are involved in very few deaths or injuries. The 60-year-old auto industry has almost no performance qualification standards whatsoever.

Now—Fatigue Performance Formerly Available Only in Specials!

...with New UNBRAKO K16 Socket Head Cap Screws

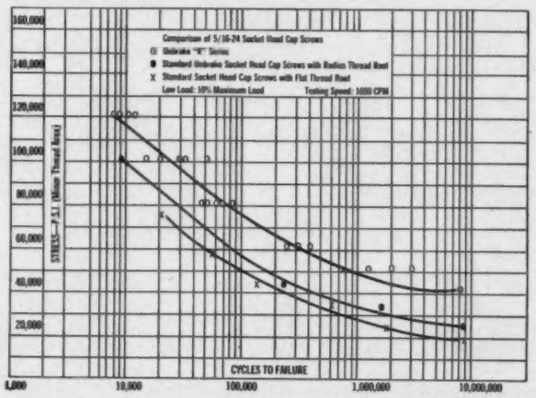
If you have socket-head applications demanding extra-normal fatigue capacity . . . if you have been using costly specials to get fatigue strength . . . here at last is a standard fastener designed specifically to solve your problem.

New UNBRAKO K16 socket head cap screws give you *a bonus of 300% more fatigue life.*

How does SPS achieve this special fatigue performance in a standard fastener? Primarily through extra operations during manufacture. Among them—

- Threads rolled *after* heat treat for extra fatigue strength
- Head-to-shank fillet area cold worked after heat treat to increase fatigue resistance
- Shank precision ground after heat treat to insure no decarburization and for closer body tolerances
- Magnetic particle inspection per SPS Specifications and MIL-I-6868 to insure a reliable product
- These features are in addition to the proven UNBRAKO pHd* head, which delivers far greater holding power, and the SPS Hi-Life thread root form, which reduces stress concentrations . . . both standard on all UNBRAKO socket head cap screws.

*proper Head design



Tension-tension fatigue tests by SPS Laboratories show new UNBRAKO K16 socket head cap screw offers *twice* the fatigue life of regular UNBRAKOS.

New K16 tension fasteners were developed by SPS to replace costly specials in a growing number of critical industrial applications demanding extra-high fatigue capacity. Cross drilling is standard.

Case histories show that 90% of today's fastener failures are due to fatigue—a direct result of the trend toward more and more compact designs, with higher performance demanded of fewer or smaller components. New UNBRAKO K16 socket heads help you meet this design challenge . . . without paying for specials.

UNBRAKO K Series fasteners are available currently as socket head cap screws in standard sizes #8 through ½ in. diameter in 8740 A.Q. steel. Other configurations and series to come. See your authorized industrial distributor or write Standard Pressed Steel Co. for new Bulletin 2707. INDUSTRIAL FASTENER Division, SPS, JENKINTOWN 6, PENNA.

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DESIGN SPECIAL REPORT NEWS

Welded Diaphragm Bellows—Part II

Victor W. Wigotsky, Eastern Editor

The first part of this Special Report on welded diaphragm bellows appeared in a previous issue of DESIGN NEWS. It discussed general characteristics, basic contours, definition of applications, bellows terminals and materials.

Design Curves

The design curves and charts were prepared from test data and mathematical analysis and are based upon AM350 (AMS 5548), a precipitation hardening stainless steel, heat-treated to Rc 42-45 hardness. Curves on spring rate are approximate and serve to orient the designer rather than pinpoint exact values. Curves on life expectancy are conservative. The flat plate and nesting ripple contours generally are used in the zero to 300 psi pressure range and require a similar design approach. The single sweep and torus designs generally are used above 300 psi and require considerable different treatment. It appears desirable, therefore, to present comparable engineering data on these two contours at a later date.

Nomenclature

OD = Outside diameter

ID = Inside diameter

Span = Depth of convolution measured from OD to ID, equal to $\frac{OD-ID}{2}$. Ratio of span to OD should not be greater than 1 to 3.

P = Pitch, the distance from center of one weld bead to center of adjacent bead.

NP = Nested pitch

h = Diaphragm thickness

N = Number of convolutions. A convolution is two diaphragms welded together at ID.

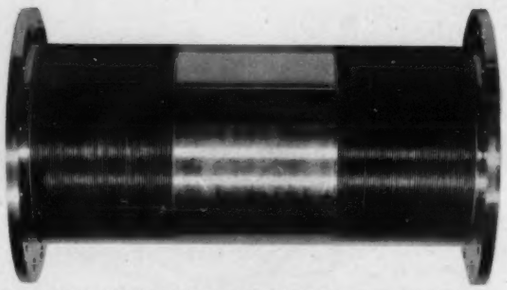
K = Spring rate, the ratio of force to stroke expressed in lb/in.

Mean diameter $= \frac{OD+ID}{2}$

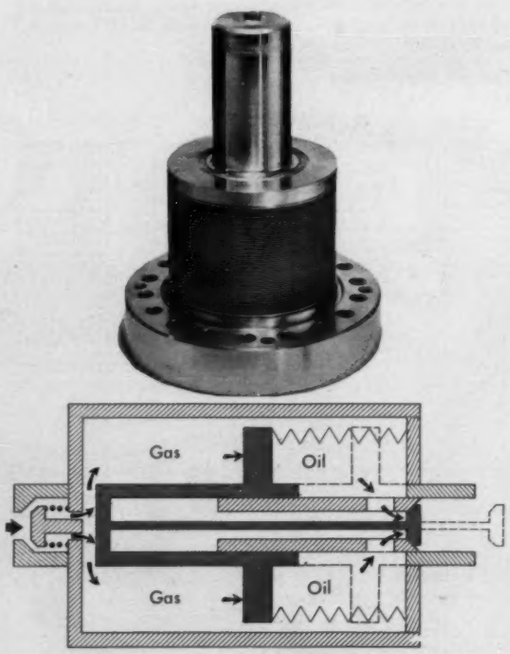
EA or A = Effective area, that surface on which pressure acts to produce thrust.

$$EA = \pi\left(\frac{OD+ID}{4}\right)^2$$

$$A/K = \frac{\text{Effective area}}{\text{Spring rate}} = \text{stroke per psi}$$



BELLOWS ASSEMBLY provides flexible connection between carrier and research aircraft. Severe axial and transverse deflections create difficult sealing problem. Flexibility is provided by nesting ripple type diaphragms.



ACCUMULATOR APPLICATION: When oil line pressure drops because of sudden demand, bellows strokes toward nested position to maintain correct oil pressure on system. Nesting ripple contour is used to obtain a long stroke for short-nested length.

Design Problem

Assume a valve application. Valve poppet is attached to a pressure-operated bellows. Maximum pressure differential is 20 psi external to bellows. Assume effective area must be approximately 0.44 sq in (related to area of valve seat). Valve lift is ¼ inch. Pressure of 20 psi shall actuate valve through full stroke and apply 4.4-lb force on seat. Linearity of stroke with pressure is desirable but not essential. Life shall be 10,000 cycles. Valve operates at room temperature with no corrosive fluids—AM 350 is acceptable. Maximum allowable OD is 1.031 inches and it is desirable to make length as short as possible. Since pressure is low and a small package is desired, the nesting ripple looks satisfactory. Bellows must move ¼ inch under a 20-psi pressure and exert a force of 4.4 lb on the seal.

(Pressure) (EA) = Force

$$\text{Pressure} = \frac{4.4 \text{ lb}}{0.44 \text{ sq in}} = 10 \text{ psi}$$

Therefore, remaining 10 psi are available for stroking the bellows. The A/K must equal $\frac{0.25 \text{ in}}{10 \text{ psi}}$;

therefore, $\frac{A}{K} = \frac{0.44}{K} = \frac{0.25}{10}$

$$K = 17.6 \text{ lb/in}$$

Longest stroke per convolution will result in least number of convolutions required and will, therefore, be shorter in overall length and cost less to manufacture. Referring to Curve No. 4 on pitch for nesting ripples, we note that largest span shown has longest stroke. Check span to OD ratio. If we use 0.350 span, OD becomes 0.748 + 0.350 = 1.098 (0.748 is mean diameter established by EA) for a ratio of $\frac{0.350}{1.098}$ or 0.319.

This is less than 1 to 3 but just under limit. However, this span is too large, since maximum OD is 1.031 inches. Consider 0.300-inch span. OD becomes 0.300 plus 0.748 = 1.048, which is still too large. Try 0.250-inch span; then 0.250 + 0.748 = 0.998, which is acceptable. Ratio of span to OD is $\frac{0.250}{0.998}$ = 0.251 (less than 1 to 3). Maximum deflection (Curve No. 4) is 0.046-plus per convolution, for 0.003-inch-

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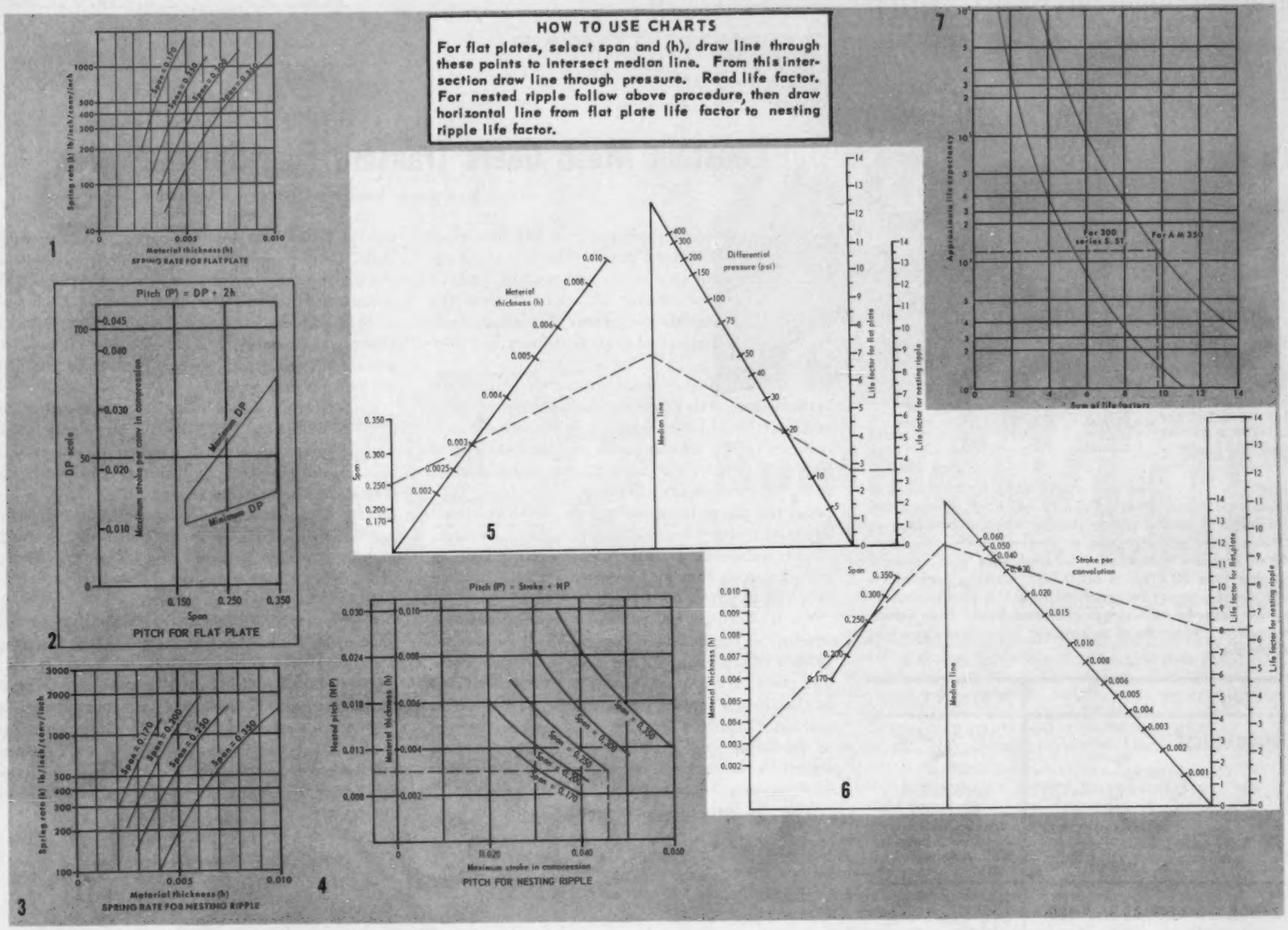
HOW TO USE CHARTS
For flat plates, select span and (h), draw line through these points to intersect median line. From this intersection draw line through pressure. Read life factor. For nested ripple follow above procedure, then draw horizontal line from flat plate life factor to nesting ripple life factor.
1
SPRING RATE FOR FLAT PLATE
2
PITCH FOR FLAT PLATE
3
SPRING RATE FOR NESTING RIPPLE
4
PITCH FOR NESTING RIPPLE
5
6
7

thick diaphragm. Referring to spring rate Curve No. 3, we can expect about 160 lb/in/convolution times 0.748 = 120 lb/in/convolution; then $\frac{120 \text{ lb/in/conv}}{17.6 \text{ lb/in}}$ = N = 6.84 conv (use 7). A stroke of 0.46 in/conv times 7 conv = 0.322-inch total stroke possible, which is well over 0.250-inch valve lift. If we consider a smaller span, 0.200 inch with 0.0025-inch thick material,

K = 240 lb/in/conv times 0.748 = 179.5 lb/in/conv; which would require

$$\frac{179.5 \text{ lb/in/conv}}{17.6 \text{ lb/in}} = 10.2 \text{ conv.}$$

The 0.250-inch span and 0.003-inch thickness therefore seem best.

Let us examine life expectancy. Referring to Curve No. 5, life factor (LF) is 3.5. In order to obtain LF for stroke, we determine stroke per convolution to be $\frac{0.250 \text{ inch}}{7 \text{ conv}}$ = 0.0357 in/conv.

From Curve No. 6, we read LF = 6.3. Therefore, 3.5 + 6.3 = 9.8 total LF. Life expectancy Curve No. 7 indicates about 12,000 cycles.

From the foregoing we determine the final bellows design specification to be:

Contour = nesting ripple
Material = AM 350
h = 0.003 inch
Span = 0.250 inch
OD = 0.250 + 0.748 = 0.998 inch
ID = 0.748 − 0.250 = 0.498 inch
N = 7
K = $\frac{120 \text{ lb/in/conv}}{7 \text{ conv}}$ = 17.1 lb/in
P = 0.046-inch maximum stroke + 0.010 NP = 0.056 inch.
Free length of bellows = 7 conv times 0.056-inch pitch = 0.392 inch.

Design information presented in this article was provided by the Metal Bellows Corp., Wellesley, Mass. Illustrations were provided by Minneapolis-Honeywell Regulator Co.; Pacific Scientific Co.; Crosby Valve & Gage Co.; General Controls Co. (Hammel-Dahl Div.); North American Aviation, Inc., and Metal Bellows Corp.

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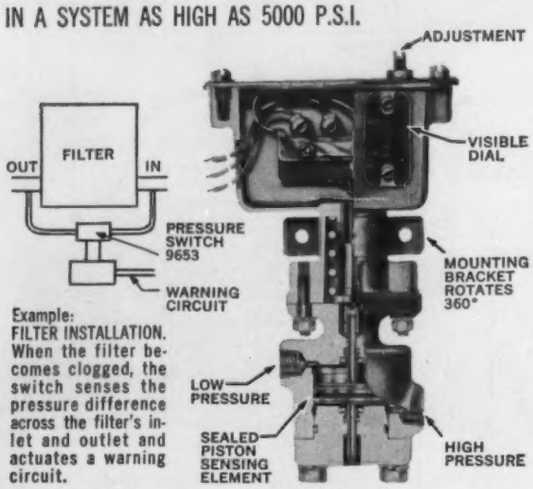

Example: FILTER INSTALLATION. When the filter becomes clogged, the switch senses the pressure difference across the filter's inlet and outlet and actuates a warning circuit.

The new Model 9653 is constructed to sense a difference from 5 P.S.I. to 140 P.S.I. between two pressures. A sealed piston sensing element actuates an electric circuit on increasing or decreasing of a predetermined pressure difference. It is applicable to oil systems ranging from 50 P.S.I. to 6000 P.S.I. working pressure. A high proof pressure rating of 9000 P.S.I. is your protection against damage from surges and shock loads. Field setting is simplified by means of an external adjustment screw and visible dial.

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Constant Mesh Gears Transmit Four-Speed Power

Edward W. Schrader, Western Editor

Gears remain in constant mesh in the four-speed power transmission for a tractor. The four speed settings range from two to six-and-one-half mph in either forward or reverse direction. Because the gears never change their direction of rotation, shock loading to the individual gears is reduced to a minimum.

Hydraulic clutches mounted on the gear shafts between gear trains provide the selection of speed and direction of power transmitted through the unit.

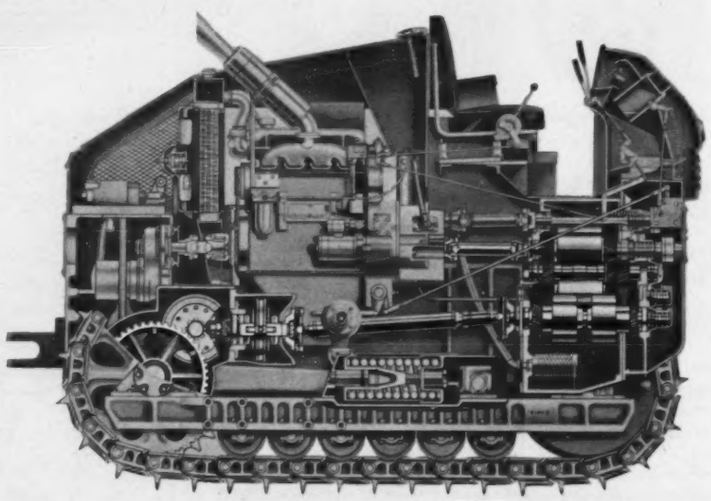
Power for the crawler tracks goes from the engine through a torque converter to the transmission input shaft. A pair of clutches mounted on the input shaft passes the power to either or both of the right and left-hand tracks. Clutches located in the early stages of gear reduction are subject to less torque loading and, therefore, they may be smaller than if located in the drive wheels.

For simplicity, consider the power transmitted to one crawler track. The opposite side will be similar. With a clutch engaged, the input shaft gear transmits power to a counter shaft. The power then flows to the change speed shaft by means of a clutched gear on this shaft. This power in turn is imparted to the output shaft by means of a clutched gear on the output shaft. All of the gears in the train are in constant mesh.

The transmission has two output shafts, each receiving power in a similar manner from the input shaft. Torque tubes attached to the output shafts of the transmission deliver power to bevel gears, which in turn drive the right and left crawlers. Each gear in the transmission is paired with a clutch into a clutch gear assembly. The clutches on a clutch shaft are also in pairs, and when one clutch is engaged, the other is disengaged.

Each clutch is keyed to its respective shaft. The clutches are operated by hydraulic pressure, with oil supplied through drilled passages in the shafts. When fluid pressure is applied to pistons within the clutch, the clutch plates engage.

The plates in each clutch are positioned in alternate order in the clutch drum. The opposing clutch plates are meshed by means of teeth with the clutch drum. They rotate whenever the shaft rotates. The friction clutch plates are meshed by means of teeth with the gear. They rotate whenever the gear rotates, or they idle whenever the gear idles. Engaging a clutch, therefore, causes a gear to begin rotating with an already rotating shaft, or engagement causes a shaft to begin rotating with an already rotating gear. Springs disengage the clutch plates when the hydraulic pressure is removed. The four-speed transmission is a design development of The Eimco Corp., Salt Lake City, Utah, and is used to power the Model 103 Tractor.



CROSS-SECTION OF TRACTOR shows four-speed transmission mounted forward. Power take-off shafts are provided at rear of tractor with direct coupling to engine. Two additional power take-off shafts are provided forward in tractor, one passing through torque converter and tied in with transmission speed. Third shaft is high-speed and independent of torque converter and transmission.

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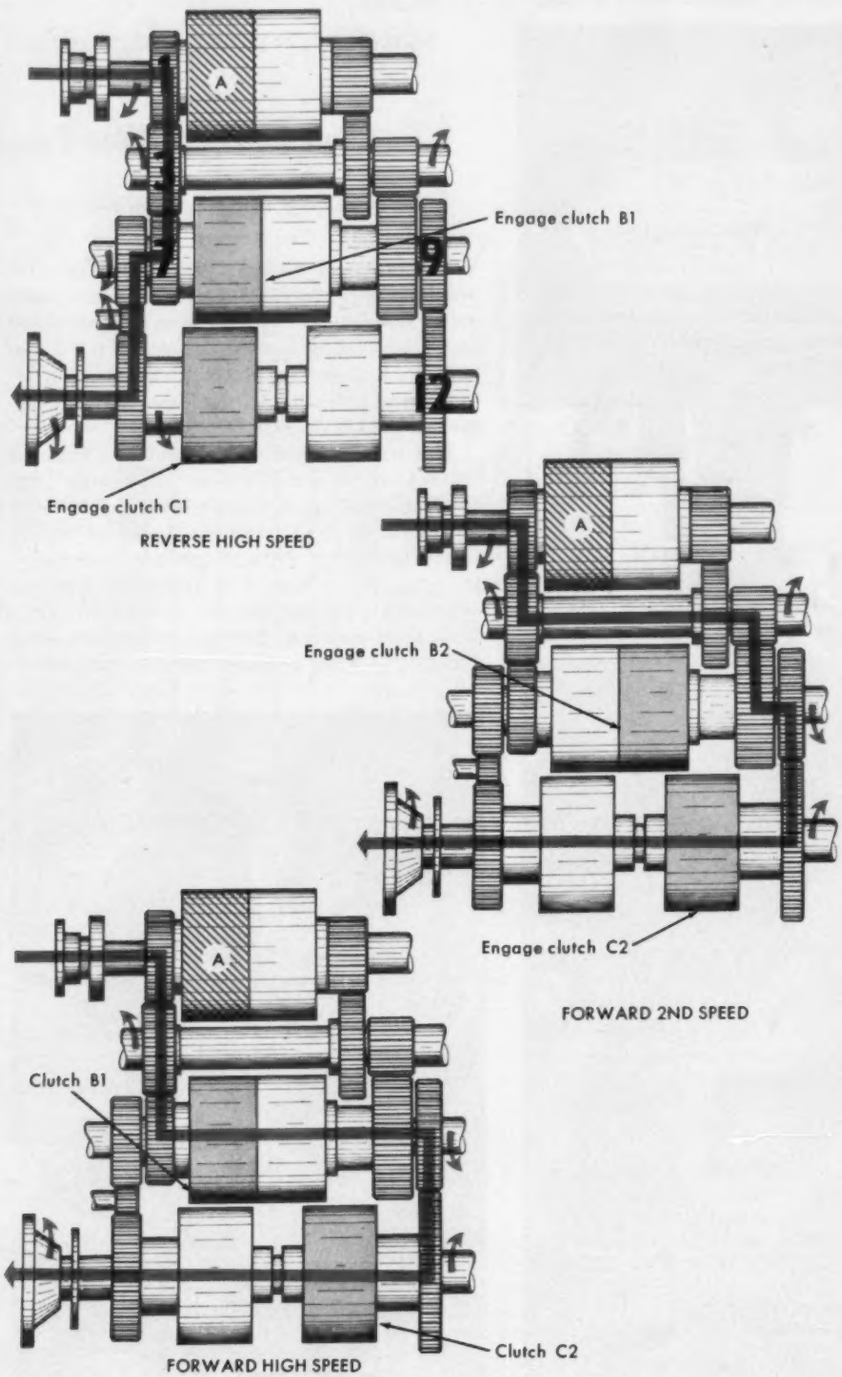

DIAGRAMS show power transmitter to left-hand track through gears and clutches. With clutch A engaged, power flows from input shaft through gear 1, to counter shaft containing gear 3. For forward high speed, clutch B1 engages to transmit power from gear 7 to gear 9 along same shaft centerline. Gear 9 drives gear 12, and clutch C2 engages output shaft.

FORWARD DRIVE AT SECOND SPEED: clutch B2 engages and clutch B1 disengages, causing power to transfer from counter shaft to clutch shaft using greater speed reduction.

REVERSE HIGH-SPEED POWER is transmitted to output shaft through clutch C1. Output shaft reverses rotation, but gears always remain in mesh and rotate in same direction.

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IDEAS . . .

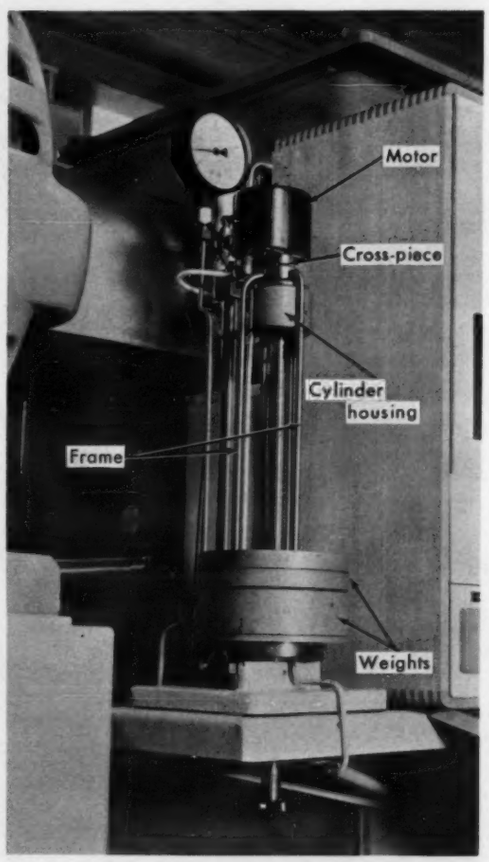
MECHANICAL DEVICES

Rotating Spool-Valve Piston

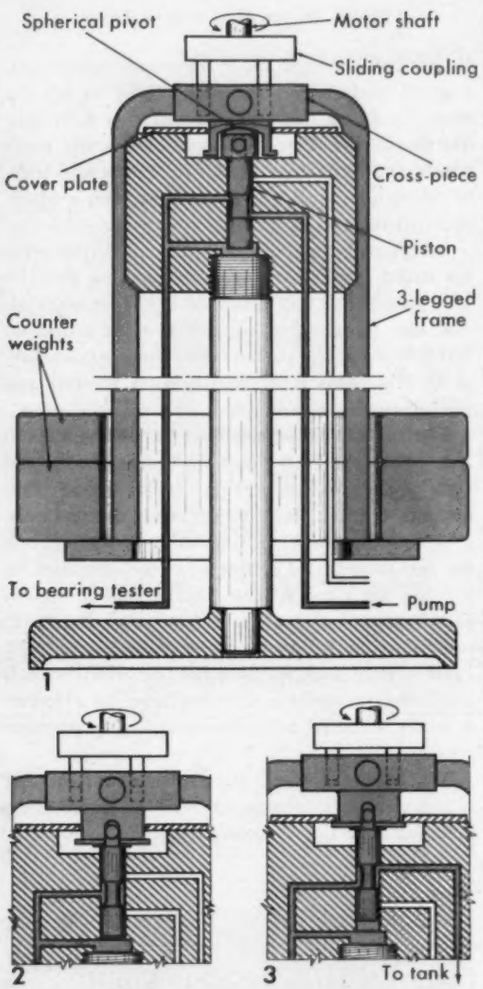
Volrath Holmboe, Correspondent in Sweden

Slow rotation of the spool-valve piston in a hydraulic pressure regulator keeps friction to a minimum. Continuous relative motion between piston and valve body maintains an unbroken oil film and cuts high starting forces or sticking. The arrangement provides increased accuracy and permits smaller dimensions.

This regulator is used to maintain a constant radial force in a machine for life testing large ball bearings. Regulator and testing machine were developed by SKF, Svenska Kullagerfabriken, Göteborg, Sweden. Piston rotation at three rpm is by means of a low-speed electric motor from Société Industrielle de Sonceboz S.A., Switzerland. With an area of only 20 mm², the piston receives a load of 1:10,000 of that of the testing machine.



Cuts Regulator Friction



MOTOR ROTATES VALVE SPOOL together with three-legged frame. These parts also move vertically. Hydraulic pressure on piston is balanced by mechanical counterweights which thus determine pressure maintained and force applied to bearing under test. Piston motion opens proper valve section. Frame is pivoted at upper end of piston. Spherical pivot surfaces of different radii absorb misalignment between frame and piston because of oscillations of counterweights. Pin through extension of piston rod fits into slots in cross-piece at top of frame to insure positive transmission of torque. Sliding coupling between rotating unit and motor permits relative vertical motion. Coupling consists of three pins extending from flange at motor shaft end. These pins fit into corresponding holes in cross-piece. Piston stroke is limited mechanically by cover plate and collar on cross-piece, and cylinder end and collar on extension of piston rod.

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Acetone	good	poor	fair	poor	poor	fair	poor	poor
Alcohols	excellent	poor	good	good	good	fair	good	excellent
Alkalis	good	poor	excellent	good	good	fair	good	good
Aliphatic hydrocarbons	poor	good	good	good	excellent	poor	excellent	excellent
Aromatic hydrocarbons	poor	poor	poor	fair	good	poor	good	excellent
Corona	good	good	excellent	good	poor	excellent	good	excellent
Corrosive chemicals	good	fair	excellent	good	fair	good	fair	excellent
Ethylene glycol	excellent	poor	good	good	good	fair	good	excellent
Gasolines	poor	poor	poor	fair	excellent	poor	excellent	excellent
Greases	poor	good	good	good	excellent	poor	excellent	excellent
Hot hydraulic fluids	good	good	good	poor	fair	fair	fair	good
Jet fuels	poor	poor	poor	fair	good	poor	good	excellent
Non-oxidizing acids, bases	good	poor	good	good	good	good	good	excellent
Mineral, vegetable oils	fair	good	good	good	excellent	poor	excellent	excellent
Petroleum oils	poor	good	good	good	excellent	poor	excellent	excellent
Phenol	excellent	poor	fair	fair	poor	poor	poor	good
Ozone	good	good	excellent	good	poor	excellent	excellent	excellent
Oxygen, oxidation	excellent	good	excellent	good	poor	excellent	excellent	excellent
Solvents	poor	fair	fair	fair	good	poor	good	excellent
Sunlight	good	good	excellent	good	poor	excellent	good	excellent

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Scroll Shaft

Edward W. Schrader, Western Editor

In the reel-launcher for a supersonic tow target, a scroll shaft moves the reel axially to lay the wire evenly on the reel. The wire is 0.040-inch dia music wire. The reel drum carries and level-winds approximately 34,500 ft of this size wire, or the drum carries the drum's volumetric equivalent of stepped or tapered tow wire.

An air turbine operating up to 5500 rpm turns the drum. This provides a cable reeling speed of 1840 fpm with a full drum, or 1190 fpm when all tow line is extended. At the low air speeds of 200-250 knots, the turbine develops approximately 12 bhp. This is sufficient power to start and reel all tow line extended.

The launcher is attached to the reel by a rotatable pylon. A 28v d-c motor mounted in the tail cone of the tow reel section driving a gear train revolves the launcher 90 deg about the reel axis.

A single control unit in the cockpit controls the reel-launcher. Turbine speed is controlled by varying the pitch of the turbine blades. In the pilot's control unit are a turbine pitch indicator, turbine rpm indicator, cable footage counter, cable cutter switch, launcher up/down switch and launcher position warning light. An automatic brake actuated by an overspeed relay prevents reel overspeeds.

The Model DXL-6C Supersonic Reel-Launcher is a design development of Del Mar Engineering Laboratories, Los Angeles, Calif.

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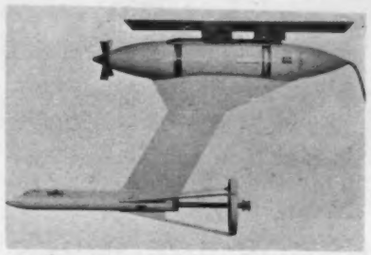
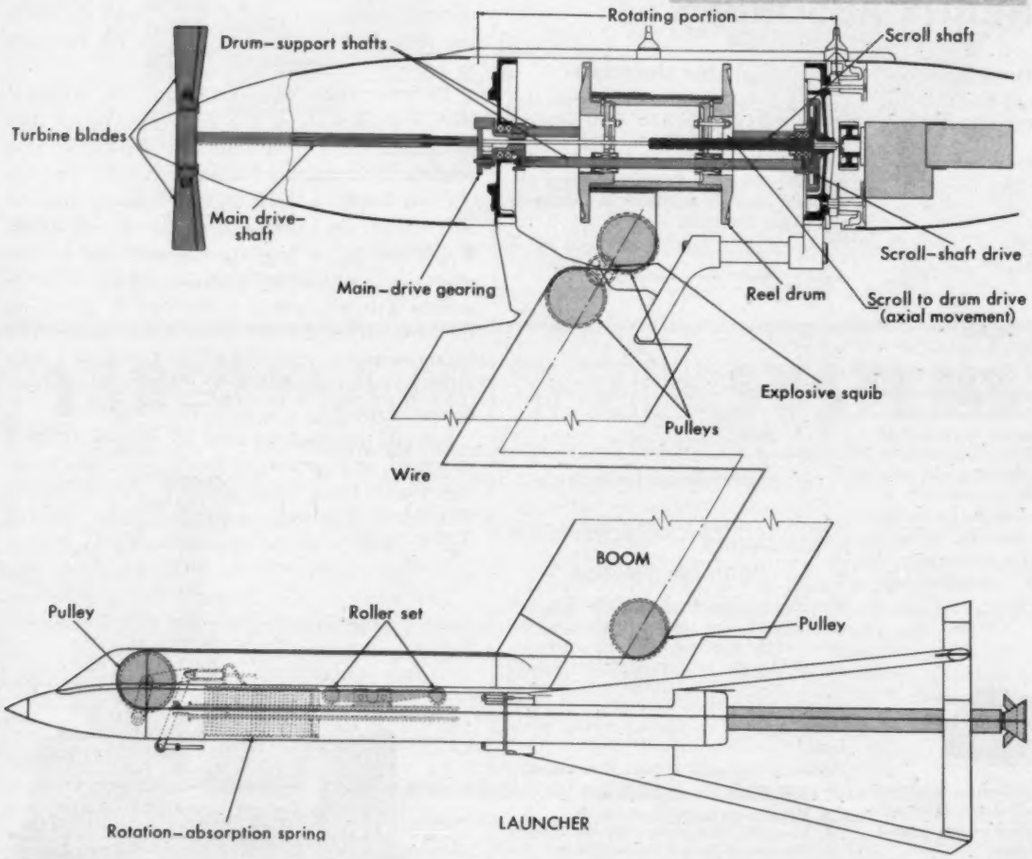
Level-Winds Wire for Supersonic Tow Target





REEL-LAUNCHER mounts on single pylon on wing. Launcher and target rotate from horizontal stowed position to down position for towing. This positions launcher far enough below wing to launch and recover target in undisturbed air. When stowed in up position, target is well above ground clearance line.

REEL DRUM rotates about scroll shaft to move drum axially for level winding of tow wire. Wire passes over three pulleys in boom to fourth pulley on launcher and then to tow target. An explosive squib operates cable cutter between first two pulleys in event target is damaged by hit. Launcher contains large spring to absorb rotational energy of tow reel when target is recovered into launcher. Friction material in aft portion of launcher tube prevents rotation of target in launcher. Three nylon roller sets at 120 deg guide spring rod movement.

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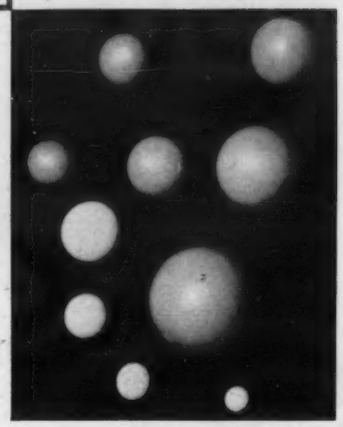

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#5 HONEYCOMB AS AN ENERGY ABSORBER

While honeycomb materials are used principally in light-weight, high-strength sandwich structures, increasing emphasis has been placed on the use of honeycomb to control forces exerted on decelerating objects. Such control is highly desirable in cushioning the impact of air-dropped supplies, protecting instrumented missile assemblies, providing impact-limiting linkages in landing gear structures, packaging fragile items, and protecting human occupants of high speed vehicles.

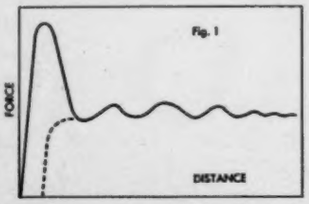
The Problem

Instances requiring impact energy absorption are generally typified by low tolerable deceleration rates for the structure or its contents, high impact velocities, and small maximum allowable stopping distances. Such absorbers as mechanical springs, sponge or solid rubber, foams, cork, and wadding generally exhibit spring characteristics, in that the force transmitted through these absorbers to the object being stopped increases continuously through the distance in which the absorbers contract. In addition, many of these materials do not absorb energy, but merely store it for release as rebound energy.

If an absorber could exert a relatively constant non-rebound force throughout the entire stopping distance, that distance could be shortened, or alternately, the maximum force acting on the object in the same stopping distance could be materially reduced.

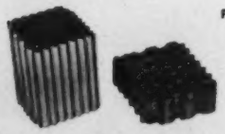
Advantages of Honeycomb

Honeycomb core materials tend to follow such a constant force curve, as shown in Figure 1.



The initial peak on the curve represents the point at which compressive failure begins. This peak can be lowered by prestressing the core to produce slight initial compressive failure. When subjected to further or subsequent loading, the prestressed core proceeds immediately to carry the crushing load, as shown by the dashed line curve in Figure 1.

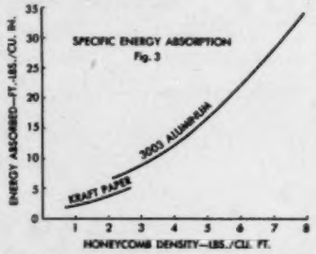
Figure 2 illustrates the appearance of aluminum honeycomb core before and after compressive failure.



By designing a honeycomb core assembly with a specified cell depth this constant force can be applied over a predetermined stopping distance.

Available Materials

These principles apply to aluminum and paper honeycomb, and most similar honeycomb core materials fabricated from ductile metals and fabrics. Figure 3 indicates the general range of energy absorption capacity available in aluminum and paper materials.



These capacities can be further increased by filling the cells with various foamed materials.

Optimum Solution

The choice of materials by the designer will depend upon the particular requirements of the application. But it seems apparent that the utilization of honeycomb offers the optimum solution—in terms of weight and volumetric efficiency—to many types of energy absorption problems.

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IDEAS . . .

MECHANICAL DEVICES

Adjustable Rolls

E. J. Stefanides, Central States Editor

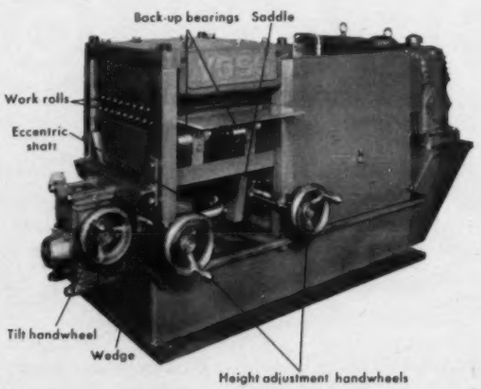
A new parts straightening machine automatically flattens stamped parts by passing them between a series of small-diameter work rolls supported by multiple large-diameter back-up bearings. The rolling action works the parts to relieve stresses and straightens them to within 0.002 to 0.003 inch of true flatness in one pass.

This method completely eliminates hand straightening. Its success depends to a large extent on precise control of the space between the working rolls and on adequate support for the rolls to prevent their flexing.

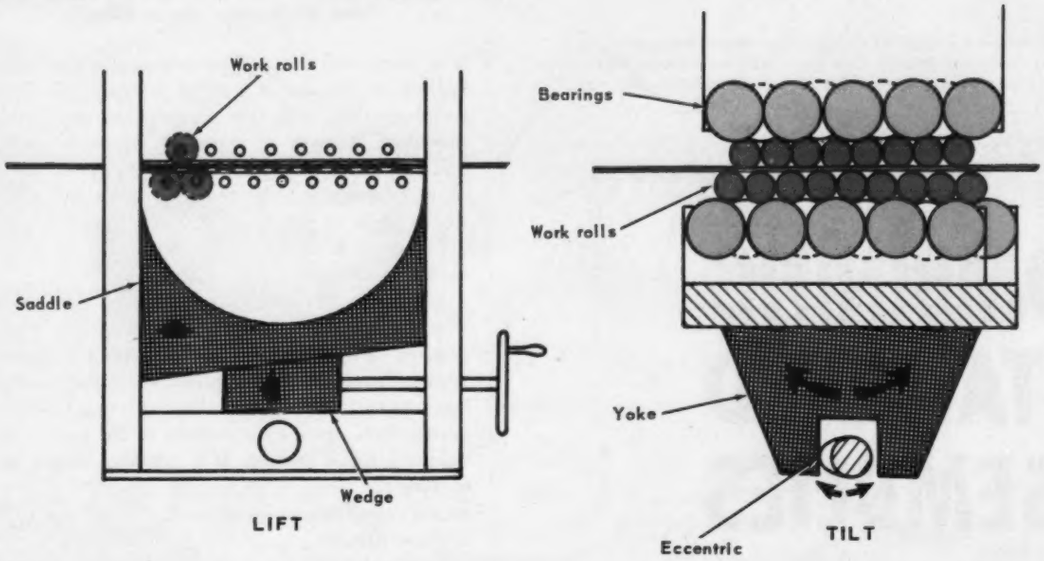
To solve both these problems, the designers have applied some of the techniques which they have been using successfully on large mill-roller levelers. First, an inverted design is used. The upper roll frame is fixed and all spacing and tilt adjustments are made with the lower roll frame. Roller spacing or height is accomplished by two screw-positioned wedges manually driven by handwheels. Tilt adjustment is provided by mounting the lower roll frame in a semicircular saddle. The tilting moment is applied to the frame by a yoke actuated by an eccentric shaft. Shaft is handwheel-driven through a gear-reduction unit.

Second, the working rolls are supported by a staggered arrangement of heavy-duty roller bearings cantilevered from pedestal-mounted shafts. This method provides maximum roller, bearing and shaft sizes in the space allowed, as well as maximum rigidity for the working rollers.

This machine was designed and is manufactured by the Voss Engineering Co., Pittsburgh, Pa.



Straighten Parts in Single Pass



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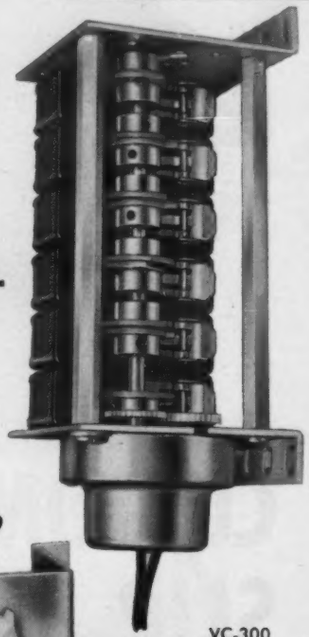
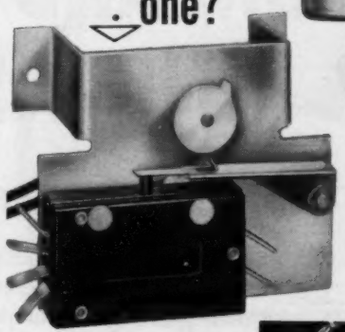
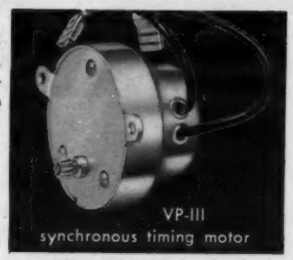
What's so uncommon about this timer... or this one?



VC-300
variable-cam timer



GT-100
general-purpose timer



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What's uncommon about these timers? It's the *motor*, the heart of any timing device, which is common to both. *Uncommon* because it is uniquely adaptable to unusual configurations. The VP-III motor offers extra reliability, too — with positive lubrication, heavy-duty gear train, and variable pole rotor. In addition to these versatile, reliable motors, other features of Lake-City timers merit careful consideration. The VC-300 variable-cam, for instance, is the only one made of corrosion-resistant *aluminum*. Less wear. Easier to adjust. VC-300 timers are available with up to ten 25-amp. circuits . . . for timing cycles from five seconds to several days. Or consider the GT-100 general-purpose timer — a single-circuit "work-horse" for anything from signs to systems. Speeds from 1/60 to 10 rpm, with 25-amp. DPDT or SPDT switch. Lake-City's VC-100 and VC-200 single-circuit variable-cam timers, too, use motors from the VP-III family.

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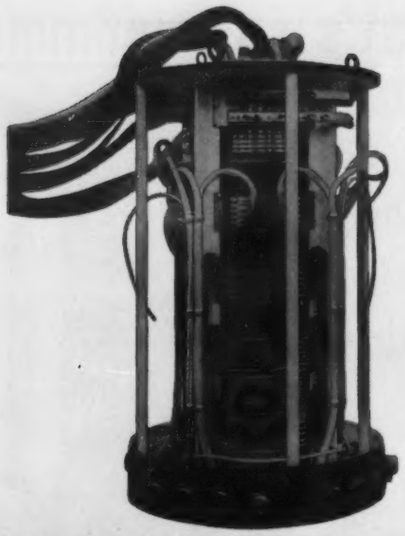

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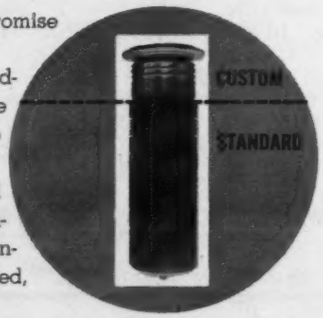

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IDEAS . . .

MECHANICAL DEVICES

Lever Effect of

Victor W. Wigotsky, Eastern Editor

The lever effect caused by inflating a flat hose against the bottom of a roller produces efficient linear motion with few components and great flexibility. Length of travel is adjusted easily, and any tangential motion or degree of turn around corners is incorporated without any additional parts or assembly changes. The low-cost apparatus can be fabricated essentially of sheet metal stampings or die castings.

The roller is attached to a carriage and rides over the hose. The latter is supported in a wing channel which also guides the roller support wheels. Air or hydraulic pressure applied to the hose opens it to a round shape which creates a prying force against the bottom of the roller, inducing a linear motion. It is possible, simply by curving the track, to go around corners or adjust to any required combination of straight and curvilinear motion.

The design has other advantages; one of these is the self-sealing characteristic resulting from the cocking action caused by the application of the load at the guide rollers and the prying effect of the pressure against the bottom of the hose roller.

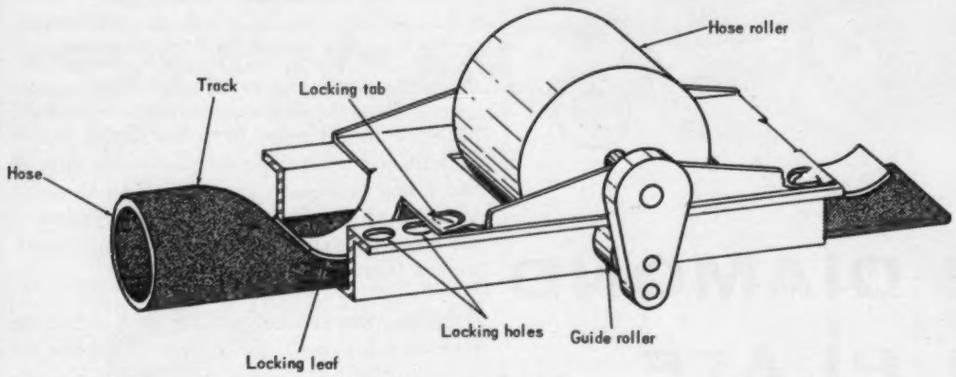
The design uses hose inflation for integration of an automatic locking device for the carriage. Symmetrical spring-loaded leaves, individually pivoted on the roller axle, provide positive locking in either direction by the engagement of tabs when the hose is not pressurized. The expanding hose raises the tab on the pressure side to unlock the carriage.

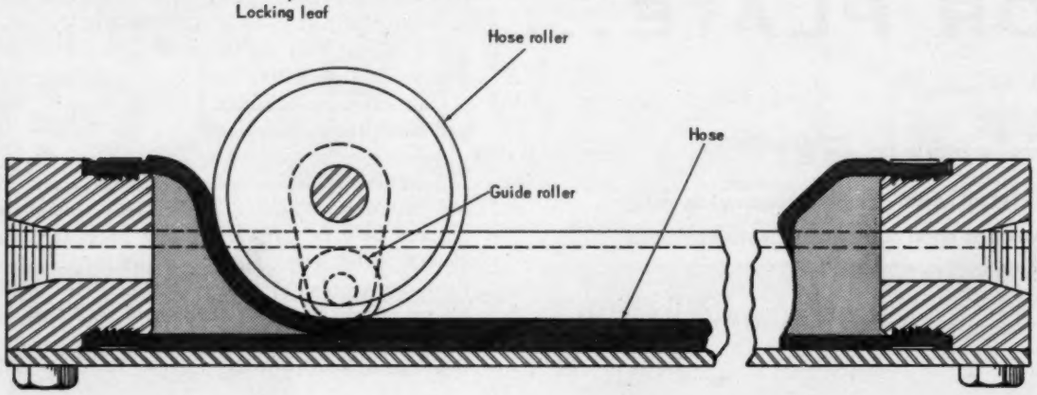
Choice of a flat hose substantially improves the actuator's operation. A round hose has been used, in which case the roller had to flatten and seal the hose, resulting in loss of efficiency from increased friction.

The hose linear actuator was designed by The Jerome Murray Corp., New York, N. Y.

CURVILINEAR MOTION REQUIRED, for example, in wrap-around windshield wiper, is accomplished simply by curving track. Also, where more power is required, it is possible to install two hoses in I-beam.

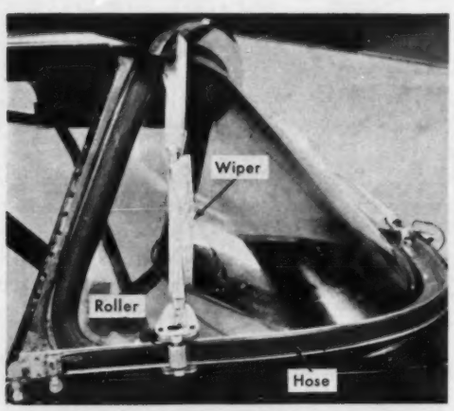
Inflated Flat Hose Produces Efficient Linear Motion

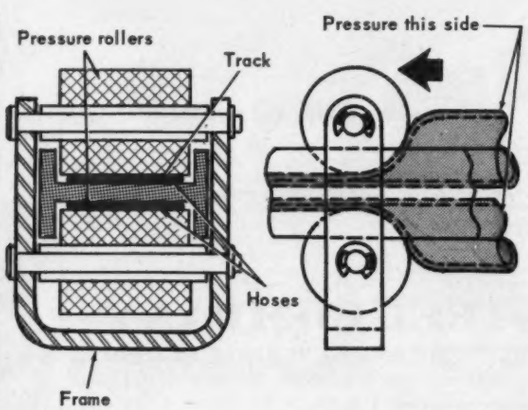




HOSE LINEAR ACTUATOR

HOSE ACTUATOR, requiring no packing, seals at any position along its length as carriage tilts roller against unpressurized flat hose. Stroke length is virtually unlimited. Rising movement of roller when hose is inflated is used to provide locking device for carriage. Spring-loaded locking leaves are pivoted individually on axle. With no pressure in hose, tabs on leaves engage holes in track. When hose is pressurized, it raises leaf on pressure side, lifting tab from hole and permitting carriage motion. Tab on flat side simply ratchets along track.





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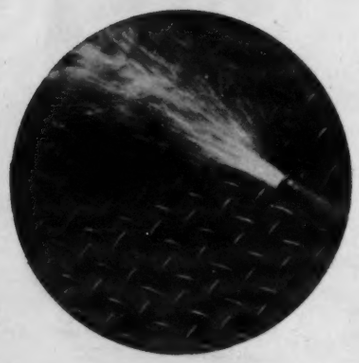

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IDEAS . . .

MECHANICAL DEVICES

Threaded Double Eccentrics

Lars G. Soderholm, Midwest Editor

A new, economical Micro-Projector designed for the hobby field uses two threaded double eccentrics to align the projector bulb filament to the projector optical system. The low-voltage projector bulb operates inside a styrene housing through two plastic condenser lenses. The optical system is highly efficient, considering the brightness of the image projected by the small 6v bulb supplying the illumination.

Because the location of a filament within the bulb cannot be predicted, a means of varying the bulb position had to be incorporated in the projector design. This was done through double eccentrics and allows the user to get even lighting of the screen or to accent certain parts of the projected image with light.

Since inexperienced persons are expected to use the Micro-Projector, the current voltage is reduced by a 6v transformer that plugs into an electric outlet. The lamp bulb which supplies the light draws only 0.3 amp. Because of the small energy requirements of the bulb, it was possible to house the bulb and plastic condenser elements in a styrene housing without danger of distortion.

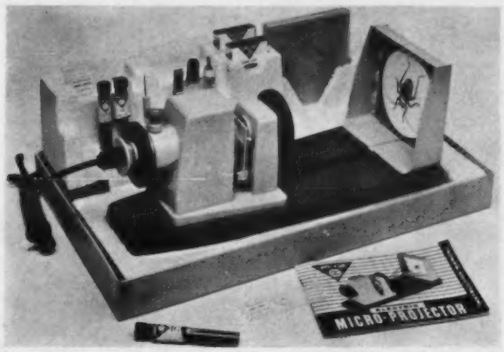
The optical system requires a large amount of the light from the lamp to be sent through the optical system to be projected on the screen. This was accomplished by using two condenser lenses situated close to the bulb. One of these lenses is an aspheric. The objective or projection lens consists of two double convex glass lenses.

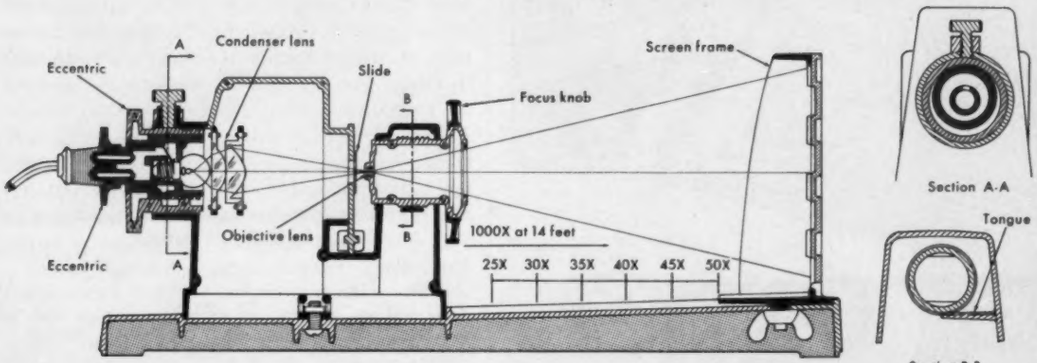
In operation, a slide with the object to be viewed is inserted in the Micro-Projector holder. The screen then can be positioned on the die-cast base until the required magnification position is established. The objective lens then can be rotated in a threaded holder to focus the image on the screen. A translucent screen is furnished for back viewing and an opaque screen for front viewing. The screen can be removed for projecting against a wall or movie screen. At 15 ft, a 1000-power magnification is obtained.

The electric Micro-Projector was designed by the John R. Miles Co., Skokie, Ill., for Skil-Craft Corp., Chicago, Ill.

Position Lamp in Micro-Projector

PROJECTION BULB is positioned by two threaded eccentrics, one turning inside the other. Locking knob secures position once set. Double plastic condenser lens sends light through slide to glass objectives. Objectives can be focused in threaded mount. Plastic tongue in housing projects into root of threads on focusing mount to remove any play.





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ANCHOR Coupling Co. Inc.

398 North Fourth Street, Libertyville, Ill.

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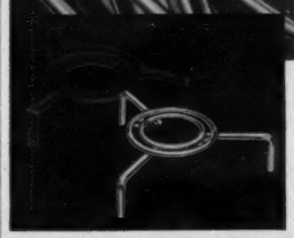
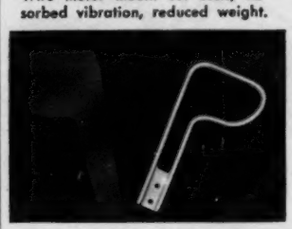
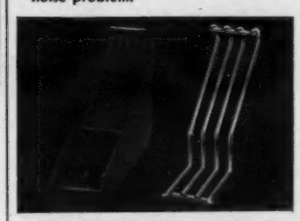


Wire motor mount cut costs, absorbed vibration, reduced weight.



Wire/strip paddle arm for cleaning unit reduced costs 70%; ended noise problem.



Wire guide is lighter, easier to clean, much lower in cost.

Wire and wire/strip components improve the quality, efficiency and appearance of finished products.

CUT COSTS

Wire and wire/strip components save on tooling, machining, and materials.

Improve Design

Wire and wire/strip are strong and light; welds are stronger than parts joined.

Modern Look

Wire and wire/strip offer functional, decorative values. Finishes include Lustre-Zinc® (also available in attractive colors), nickel, chrome, brass, cadmium and electro-polished stainless steel.

Free Package

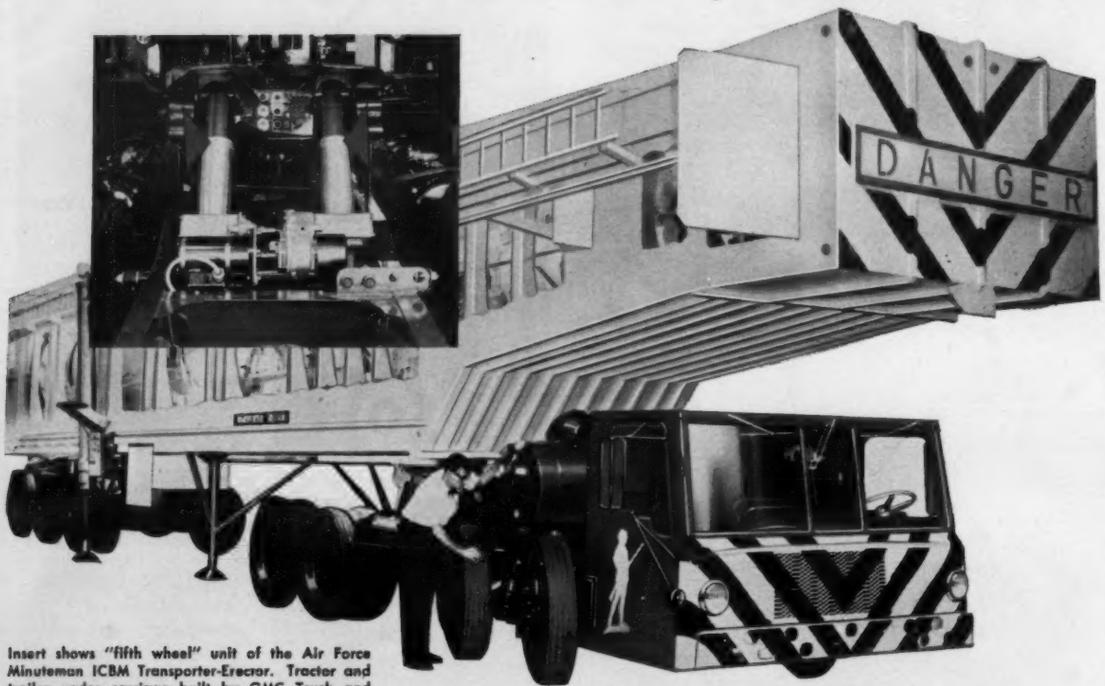
Send now for our Wire/Strip component design package. New handbook describes complete production facilities for fabricating wire forms, welded wire and strip assemblies, light stampings and staples.

E. H. Titchener AND COMPANY

64 CLINTON STREET, BINGHAMTON, NEW YORK

Circle 21 on Reader-Service Card for more information

Hefting a Heavyweight ...A SNAP with SAGINAW b/b SCREWS

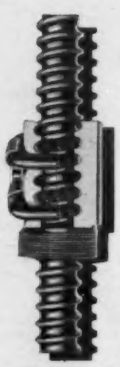


Insert shows "fifth wheel" unit of the Air Force Minuteman ICBM Transporter-Erector. Tractor and trailer under carriage built by GMC Truck and Coach Division.

Low-friction Saginaw Ball Bearing Screws allow a small electric motor in the "fifth wheel" unit to rapidly raise and lower the forward end of this transporter of a 65,000 pound missile . . . allows the transporter to pass under highway overpasses and other low clearance obstacles en-route to underground launching sites.

Also, Saginaw b/b Screws are used for leveling jacks on the rear sides of the carriage unit. The effort required to level the undercarriage is so small the jacks are hand-operated. Each of the jacks has a capacity of 65,000 pounds.

The efficiency of Saginaw Ball Bearing Screws and Splines is being used by designers of today's space, air and ground handling systems. They can lower operating costs, reduce maintenance and simplify designs. And they often reduce installation costs. Whatever your application problem, call on Saginaw to help solve it with Saginaw b/b Screws! Saginaw Steering Gear Division, General Motors Corp., Saginaw, Michigan—world's largest producers of b/b screws and splines.



WRITE TODAY FOR NEW 1961 ENGINEERING DATA BOOK OR REFER TO SWEET'S DESIGN FILE

Saginaw ball bearing Screw

Circle 22 on Reader-Service Card for more information

IDEAS . . .

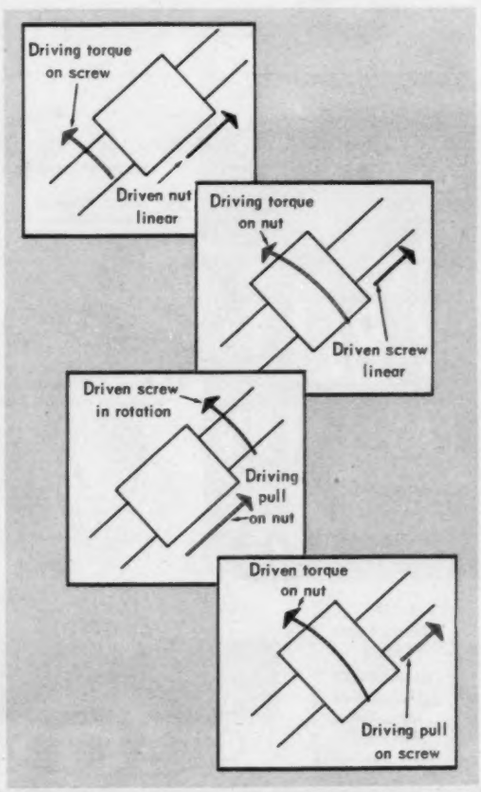
MECHANICAL DEVICES

Threaded Rollers Cut Friction

G. B. Bernard, Correspondent in France

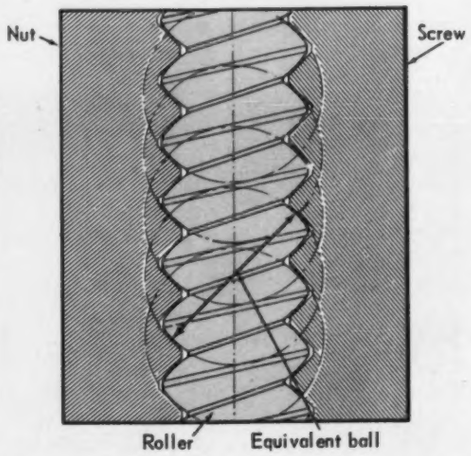
Several threaded rollers are placed between a nut and its screw to replace sliding with rolling friction. The same effect is achieved as with ball-bearing screws, but in a simpler manner.

Special triangular threads with convex faces are used. Point contact between roller, nut and screw threads provides almost pure rolling and practically no sliding friction. Contacts are equivalent to a large number of balls, whose active portions are represented by the roller thread sides. Ninety percent or more efficiency is claimed. This helicoidal bearing is used extensively in vehicles, machine tools, valve controls, nuclear industry and others. It is manufactured and marketed by "La Technique Intégrale" 18bis rue d'Anjou, Paris 8ème, France, under a Swedish patent.

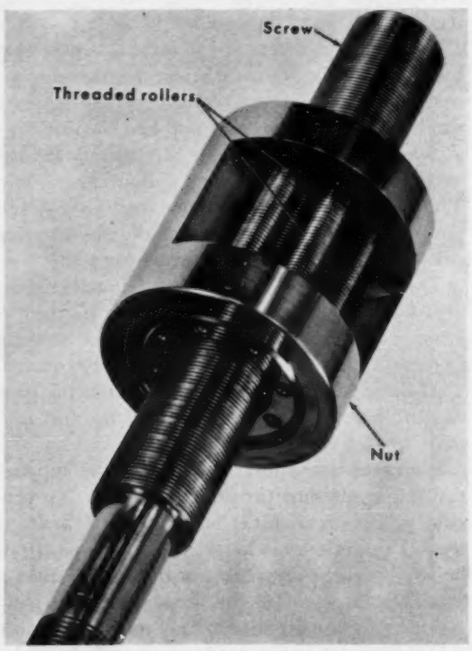


HIGH EFFICIENCY results in complete reversibility and allows all combinations of movement.

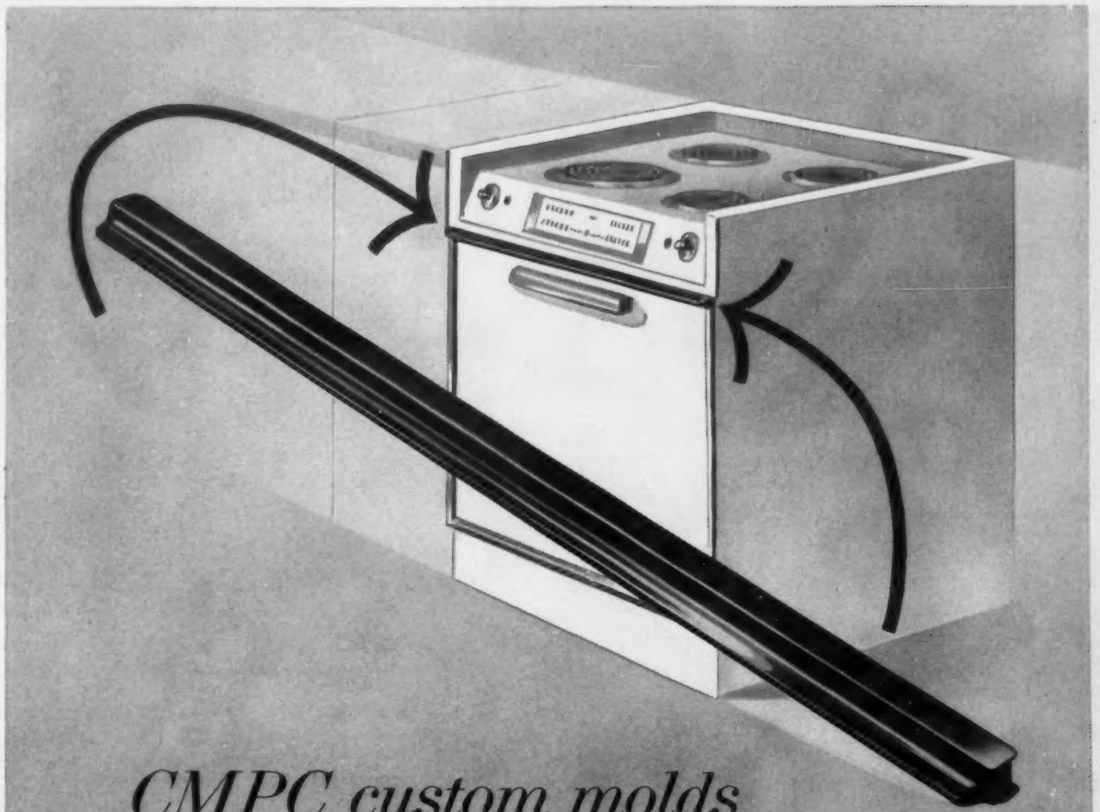
and Play in Screw Drive



EQUIVALENT BALLS of each roller are represented only by their convex contact points. Number of these equivalent balls is very great in comparison to a standard ball screw and nut, and no sliding friction between balls exists.



PRINCIPLE: Threaded rollers are between nut and screw. Rollers cannot slide, but only rotate. Pitch and width are same as those of nut. Screw threads can vary in pitch and number to achieve different advances per turn (and even reverse action) without loss of efficiency.



CMPC custom molds phenolic heat deflector for General Electric ranges

Certain models of General Electric's new line of Mark 27 built-in ranges are sporting an attractive CMPC-molded phenolic heat deflector. The 26-inch compression molded deflector, with a top continuous use temperature of 400 degrees F, is used to divert oven heat from the range control panel. By isolating controls from the effects of heat, the CMPC part helps insure longer, trouble-free service—something for which General Electric is famous.

Can the advantages of plastics be applied to your products? When you talk to CMPC, more than forty years experience plus complete compression and injection molding facilities are brought to bear on the problem.

CMPC

CHICAGO MOLDED PRODUCTS CORPORATION
1020 A North Kolmar Avenue
Chicago 51, Illinois

Please write direct to supplier, mentioning Design News

RUBBER
in Design
Engineering

PROPERTIES	Non-Oil Resistant			Oil Resistant	
	Natural	SBR	Butyl	Nitrile	Neoprene
Tear Resistance	Excellent	Poor-fair	Good	Fair	Good
Abrasion Resistance	Excellent	Good	Good	Excellent	Excellent
Compression Set Resistance	Good	Good	Good	Very good	Good
Permeability to Gases	Fair	Fair	Excellent	Very good	Very good
Aging (Sunlight)	Poor	Poor	Excellent	Fair	Excellent
Aging (Oxidation)	Good	Good	Good	Fair	Good
Aging (Heat, max. temp. F)	200	250	300	250	250
Solvent Resistance (Aliphatic Hydrocarbons)	Very poor	Very poor	Poor	Good-Exc.	Fair
(Aromatic Hydrocarbons)	Very poor	Very poor	Poor	Fair-good	Poor
Oil Resistance (Low Aniline)	Very poor	Very poor	Very poor	Fair-Exc.	Fair
Oil Resistance (High Aniline)	Very poor	Very poor	Very poor	Fair-Exc.	Good
Gasoline Resistance (Aromatic)	Very poor	Very poor	Very poor	Fair-good	Fair
Gasoline Resistance (Non-aromatic)	Very poor	Very poor	Very poor	Good-Exc.	Good
Acid Resistance (Cold, min. svc temp. F)	—65	—70	—65	—65	—50

This table gives you an idea of how some rubbers react to various conditions. In designing, consult your Garlock rubber specialist to achieve best application results.

Garlock offers dozens of different types of rubber, each carefully chosen and processed to meet your exacting needs . . . natural rubber with high tensile strength where real "rubber-like" properties are required . . . styrene butadiene rubber, the work horse of the industry—a low cost material for use where a good, rugged general purpose compound is required . . . neoprene rubber where good oil and abrasion resistance and aging characteristics are important. In addition, Garlock offers a wide range of nitrile and butyl compounds where their special properties are required. For more difficult applications Garlock offers a complete line of specialty rubbers from silicone for high and low temperature service to VITON* for extreme temperature and solvent resistance.

Thoroughly tested to meet ASTM standards. Over twenty various tests are conducted on rubber materials before, during, and after manufacture to assure top performance. First, the rubber is carefully compounded and mixed exactly to specification. Then it is measured for durometer hardness, tensile strength, elongation . . . resistance to water, weather, temperature . . . many other vital characteristics. Scientific measurements like this, using ASTM, SAE-ASTM, and military standards—plus quality control during manufacture—assure you of the finest rubber parts available.

No two rubbers are alike. Each has its own individual strong points; each performs better under one set of conditions than another. In the design stage, call in your Garlock representative. He's a specialist in rubber parts and will assist you in selecting the proper material. Then, too, he may have several cost-saving ideas to suggest. You can reach him at the nearest of the 26 Garlock sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-167, Garlock Inc., Palmyra, N. Y.

Canadian Div.: Garlock of Canada Ltd.
Plastics Div.: United States Gasket Co.

Order from the Garlock 2,000 . . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*Du Pont Trademark

GARLOCK

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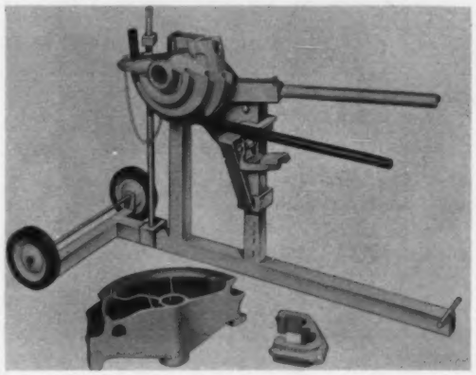
IDEAS . . .

MECHANICAL DEVICES

Ratchet-Adjustment Increases

Lars G. Soderholm, Midwest Editor



A conduit bender is made with ratchets on its support column to provide the numerous pipe support positions necessary in handling ½- to 2-inch conduit sizes. Adjustable pin positions permit the bending pawl to engage with the ratchet teeth of any sized die shoe.

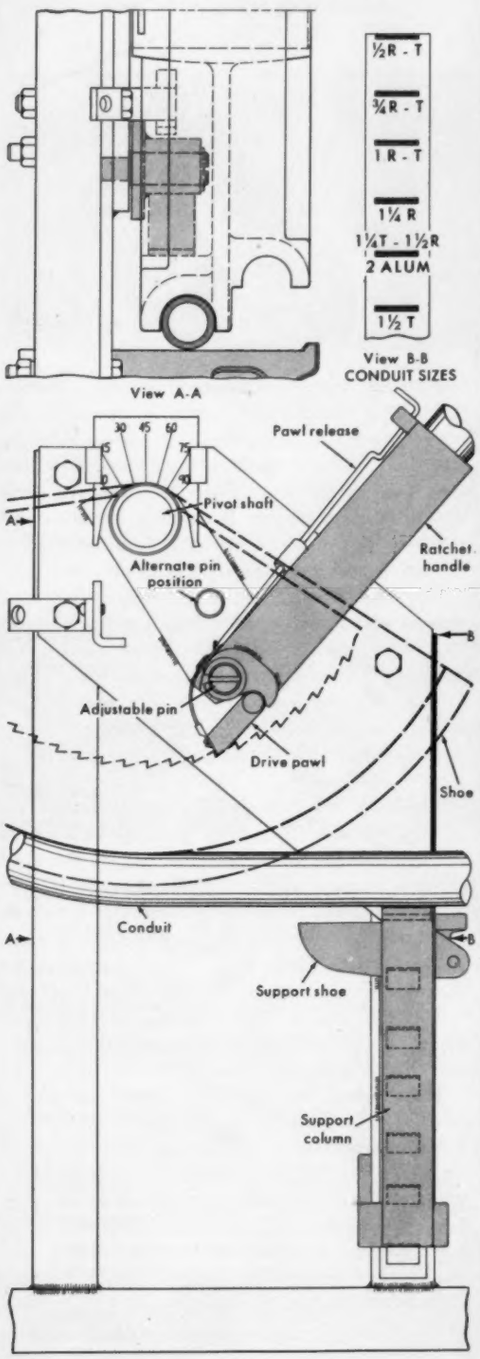
The design problem was to make a bender that could handle on a single frame all the conduit sizes that normally would require four separate size benders. This was accomplished by providing a pipe support with a range of positions for use with EMT, rigid conduit and aluminum conduit. The size range of the die shoes requires two pin positions for proper operation of the bending pawl with the die shoe ratchet.

The pipe support is positioned by ratchet teeth on the support column. Positions are marked to indicate conduit size. In addition, when bending soft conduit, curved support shoes are required. Two curved shoes are incorporated into the pipe support where they can be flipped up and into position.

For rapid, low-effort bends, a handle support cast in the die shoe provides a 1:1 ratio. To provide proper mechanical advantage for bending heavier conduit, a ratchet handle with a pawl can be used. A large movement of the handle gives a small advancement of the die shoe by the pawl as it engages the die shoe ratchet teeth. A flexible cable connected to the pawl permits release of the pawl after the handle has completed its sweep.

Ratchet-Rig mechanical conduit benders are made by the Blackhawk Mfg. Co., Industrial Div., Butler, Wis.

Bender Frame Versatility



COLOR!

another benefit with

UNITED "POP" RIVETS

SPEEDY INSTALLATION THAT CAN CUT YOUR FASTENING COSTS IN HALF . . . HIGH GRIP STRENGTH . . . and now, THE BEAUTY AND CONVENIENCE OF PRE-COLORED FASTENINGS!

Versatility, speed and ease of application, low installed cost and high grip strength are some of the qualities that have won a wide acceptance for "POP" Rivets . . . for both "blind" and "non-blind" fastening applications.

Adding still another important benefit, "POP" Rivets can now be supplied pre-finished in a wide range of stock colors (or to order in any desired hue, value, or chroma) to match, contrast or blend with any color you are using. Finish on the "POP" Rivet and on your product is never chipped or scratched when rivets are set . . . and "POP" is the ONLY fastener that offers you a complete color range!

WRITE TODAY — for a sample package and complete information on how new "POP" Colored Rivets can enhance your product's appearance, improve fastening quality, and reduce fastening costs!

UNITED "POP" RIVETS

HERE'S HOW THEY WORK
"POP" Rivets are inserted and set from the same side: (1) "POP" Rivet (a hollow rivet assembled on a solid mandrel) is inserted in the work. (2) Jaws of the easy-to-use setting tool grasp the mandrel. (3) Tool is operated. Jaws pull back. Rivet is set. Mandrel breaks and falls free.

"POP" RIVET
CLINCHING MANDREL
SETTING TOOL
JAWS PULL BACK
MANDREL BREAKS AND FALLS FREE

"POP" RIVET DIVISION · UNITED SHOE MACHINERY CORPORATION
SHELTON, CONNECTICUT, U.S.A.

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The seams don't show

Beautiful fit, beautiful look, beautiful soft drink dispenser. Beautiful job of close tolerance molding by General American. Working from wooden patterns, General American engineers designed six individual moldings. The shrinkage of each separate part was calculated to the thousandths of an inch. General American made the tools with the same precision.

Result—when this soft drink dispenser is assembled the seams are practically unnoticeable. In addition, the selection of the proper plastic, combined with General American's skill in molding, provides a product with very good luster, high impact properties, excellent stain resistance—and a reasonable price tag.

If you have a part or product that could or should be made of plastics, consult General American. In plastics, *it pays to plan with General American.*

in this 6-piece soft drink dispenser

GENERAL AMERICAN TRANSPORTATION CORPORATION

PLASTICS DIVISION GENERAL AMERICAN TRADE MARK

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IDEAS . . .

MECHANICAL DEVICES

Mobile Crane's

Ronald W. E. Martin, British Editor

Supporting the pivot-mounted jig of a mobile crane by a triangulated system of two hydraulic rams provides both slewing and luffing motions. The dual function of this arrangement simplifies design by eliminating costly slewing rings and by minimizing weight. Both rams operate separately or in unison to give the required slewing or raising and lowering telescopic jib.

The rams are attached to the sides of the crane chassis, with their upper ends at a common point on the under side of the jib. These attachments are universal ball joints. Since the rams are controlled independently, if they are extended together, the jib rises vertically. If one ram is extended and the other retracted, a horizontal movement is obtained.

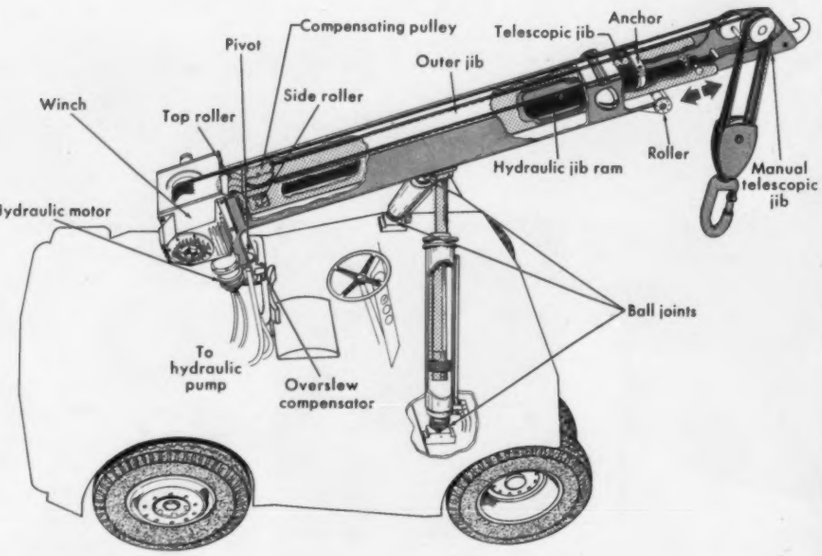
The cable hoist system includes a compensating action to insure that hook remains at constant height from the jib head. One end of the hoist cable is anchored on the hydraulic winch. The other end, after being reeved over the jib head and hook pulleys, is taken back inside the main jib and passed around a compensating pulley mounted at the top of the telescopic inner section. The cable is then brought forward again along the jib and anchored inside the forward end of the outer jib.

This system provides a "reserve" length of cable. Thus, as the inner jib assembly, carrying the compensating pulley, moves forward under action of the jib ram, cable is reeled out automatically at the correct speed. The hook is maintained in its existing position in relation to jib head, without bringing the hydraulic winch into use.

The six-ton mobile crane is designed and manufactured by British Hoist and Crane Co., Ltd., Compton, England.

Splay-Mounted Hydraulic Rams Eliminate Slewing Rings

RAMS permit full 20-ft slewing movement at jib end, together with 22-ft hook lift. Telescopic action of inner jib is guided by four rollers.



When TIME Out is PROFIT Out, SPECIFY RED SEAL POWER

Users' experience proves beyond doubt that, machine for machine, there's LESS DOWN TIME with Continental air-cooled power. Some of the reasons why:

Dependable 4-stroke cycle principle . . . rugged cast iron construction . . . patented Contex external ignition system for servicing speed and ease . . . heavy-duty components throughout. Available as optional extras are locked-in bearings, standard or heavy-duty recoil starter, electric starter and generator, automatic low oil level ignition cutoff, forged connecting rods, special power take-offs to fit any requirement.

The more pressing your need for uninterrupted engine operation, the stronger the reason for specifying dependable Red Seal power.

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Continental Motors Corporation
INDUSTRIAL AIR-COOLED ENGINE DIVISION
12800 KERCHEVAL AVENUE • DETROIT 15, MICHIGAN

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push-pull CONTROLS

Compression & Tension Type

Aircraft cable is strung with spherical steel shells in a rigid or flexible housing sealed with "O" rings. 3" standard bend radius. ¾" minimum bend radius.

Three Types:

1. *Light Duty*—Compression Ult. Load 1250 lbs.; Ult. tension 960 lbs.
2. *Heavy Duty*—Compression Ult. Load 1650 lbs.; Ult. tension 960 lbs.
3. *Extra Heavy Duty*—Compression Ult. Load 3050 lbs.; Ult. tension 3900 lbs.

Positive remote controls for actuating mechanical, hydraulic or other devices. Eliminate bell cranks, pulleys and dual cables. U. S. Patent No. 2441719. All world rights reserved. Send for ENGINEERING MANUAL No. 1551 giving complete specifications covering materials, finishes, capacities. Please address Dept. DN-61

SOUTHWEST PRODUCTS CO.
1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

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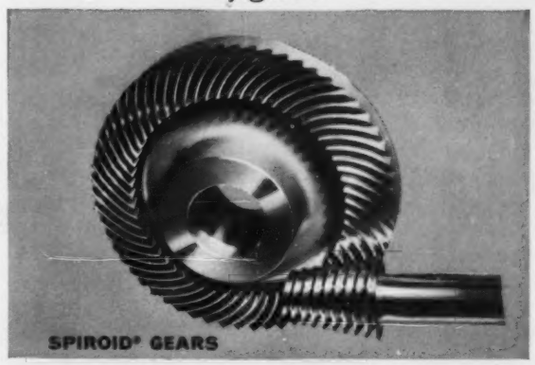
From Illinois Tool Works' unique family of gears



new gear economies with new gear efficiencies

Shown here are typical examples of outstanding developments in right-angle gearing introduced by Illinois Tool Works. Pictured above is a Spiroid gear, the first major advancement in gearing in thirty years.

SPIROID® GEARS do the same job as worm gears with this notable exception: they do it more economically and more efficiently in less space. They are recommended for application in the field of medium to high-ratio right-angle gearing. For maximum economy they may be sintered, molded or cast in metal or plastic; however, even hardened steel Spiroid gears for maximum power transmission are manufactured more cheaply than worm gears.

PLANOID® GEARS are low-ratio gears competitive with bevel and hypoid gears in efficiency and performance, but are manufactured at lower cost.

HELICON® GEARS bring even greater production economy to high quantity applications than is possible with face, bevel or worm gears.

Send today for these new gear booklets Free booklets are available giving complete information on the design, manufacture, applications and advantages of each of these gears. Request your copies today.

Spiroid® gears

SPIROID DIVISION OF ILLINOIS TOOL WORKS

2501 North Keeler Avenue Chicago 39, Illinois

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MICRO SWITCH Precision Switches

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many auxiliary actuator designs

Single-pole double-throw
(With quick-connect terminals)

Single-pole double-throw

Single-pole double-throw
(Extra-long life, mushroom head plunger)

MINIATURE BUT MIGHTY

...WITH NEW, HIGHER CAPACITIES! This versatile series of basic switches combines miniature size with new, higher electrical capacities. Switch cases and plungers are available in different plastic materials to meet varying requirements. Special high-temperature versions with synthetic mica cases withstand temperatures up to 600°F. Contact arrangements include double-throw, normally-open or normally-closed, with a choice of terminals. Models are available which conform to applicable requirements of Military Specification MIL-S-6743. "V3" Series basic switches are especially adaptable to multiple cam-operated gang-mounted systems and are also used as switching elements in many of our enclosures and assemblies. See the Yellow Pages for the nearby MICRO SWITCH Branch Office or write for Catalog 63.

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls, Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

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IDEAS . . .
MECHANICAL DEVICES

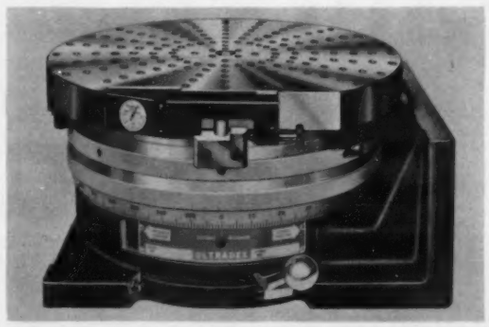
Interlocking Teeth

Robert L. Candlish, Detroit Editor

Positioning of this indexing table is controlled by a pair of ground and lapped radially serrated master plates, each containing 360 serrations. Plates seat into each other for positive locking and angular positioning. The radial serrations also control concentricity of the two plates. A unique feature in the design of the tool is that radial location accuracy of the tool tends to increase with use. All 360 serrations are engaged in every setting so any minute high spots eventually will lap themselves to zero. Indexing in degree increments is done by separating the two plates sufficiently for the serrations to clear each other and by rotating the standard plate. A degree scale on the standard plate facilitates this setting.

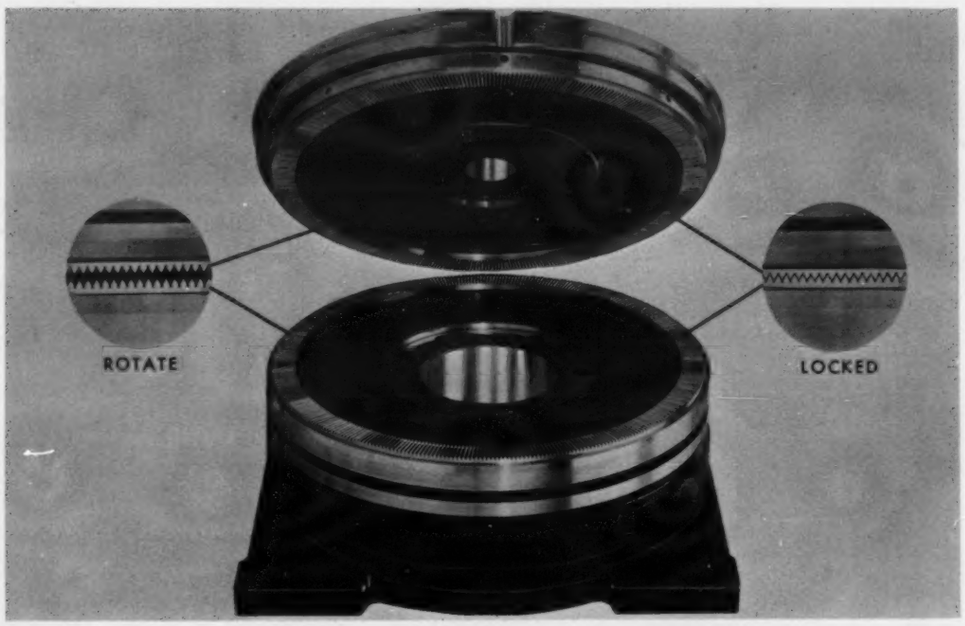
For indexing less than one deg, an adapter plate is mounted concentrically with the standard plate. Positioning of the adapter plate with respect to the standard plate is controlled by gage blocks following the sine bar principle. A special set of 20 gage blocks starting at 0.100005 size in increments of 0.000005 inch permits settings to ¼ sec. A table of sines to eight places completes the equipment.

The ¼-sec indexing "Ultradex" table is manufactured by the AA Gage Co., Detroit, Mich.

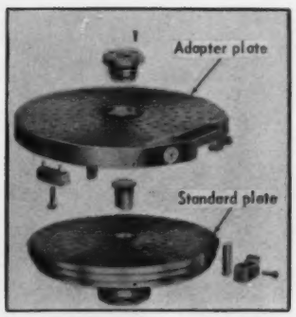


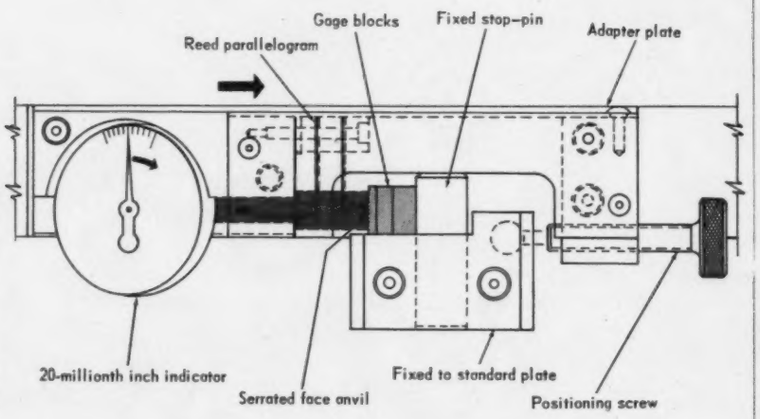
INDEXING TABLE is mounted on horizontal, vertical or right-angle base shown. Lever in front lifts standard plate for indexing. Graduated degree scale facilitates indexing by degrees. Unit shown has degree-splitting top adapter plate. Gage blocks are inserted between anvil and stop pin to position adapter plate precisely. Flexible diaphragm in base seals tool, preventing outside air from being drawn into unit when plates are moved apart for indexing.

between Plates Permit Index to 1/4-Sec Accuracy

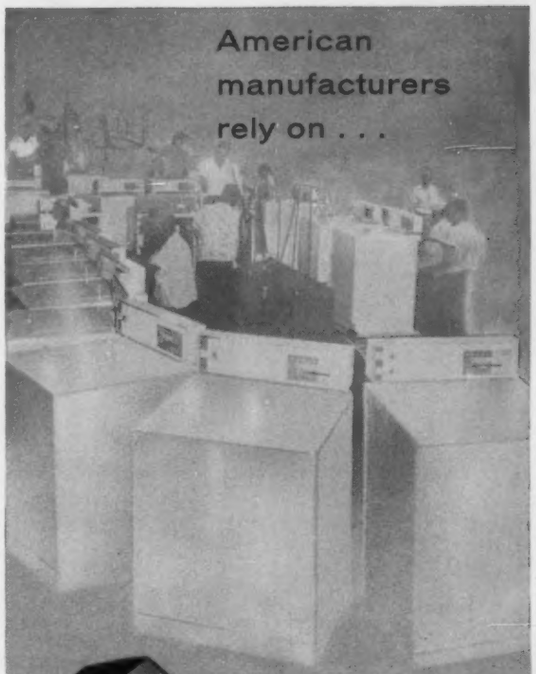


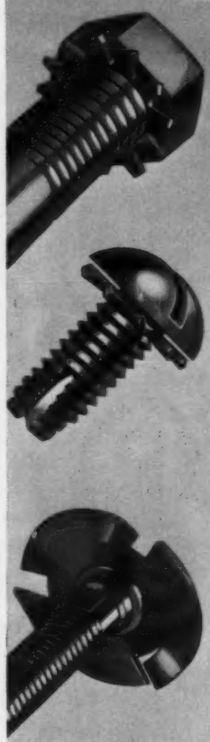
360 EVENLY SPACED SERRATIONS are mating elements of index plates. Serrations are inclined slightly upward toward center, assuring improved seating with use.





ELIMINATION OF ERRORS IN SET-UP due to "feel" is accomplished by spring anvil and dial indicator in adapter plate. Flexing-reed parallelogram on adapter plate supports anvil to position gage blocks normal to ground-steel post in standard plate. Positioning screw moves adapter relative to standard plate. Dial indicator measures deflection of parallelogram and assures constant pressure at each setting.





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PRODUCT APPLICATION

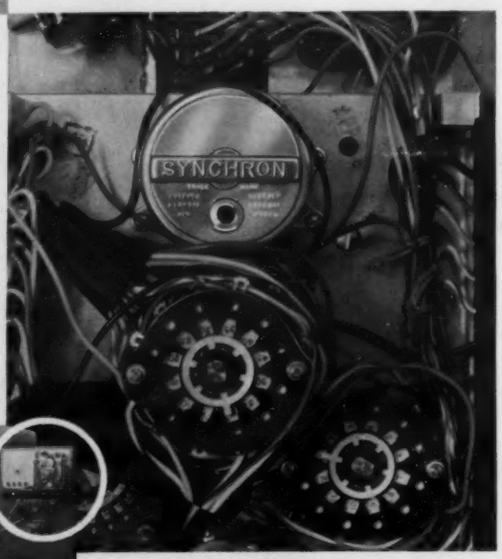
HANSEN SYNCHRON TIMING MOTORS

Schulmerich electro-mechanical

CARILLONIC BELL

systems . . .

Hansen SYNCHRON motors, the "heart" controlling the split-second timing of Schulmerich Carillonic Bells



SCHULMERICH CARILLONS, INC., world's largest manufacturer of electro-mechanical carillons, uses Hansen SYNCHRON Timing Motors to drive the program clock governing the all-automatic operation of these precision, perfect-tone instruments. Clock programming is offered at 15-minute intervals, 24 hours a day, 7 days a week. Scheduled to play at specified times, exactly to the minute — there is no allowance for plus or minus variation.

HANSEN SYNCHRON TIMING MOTORS were selected as an integral part of Schulmerich Carillonic Bells because they outperformed all other motors tested. Carefully controlled testing was based on four specifications: (1) instantaneous starting, (2) no time loss or gain, (3) absence of malfunction, and, (4) reliable, continuous operation for periods of a year or more. Depending on installation, motors operate at either 110 or 220 volts — 50 or 60 cycles.

SEND TODAY for informative folder containing specifications and technical data on all Hansen SYNCHRON motors and clock movements.

HANSEN MANUFACTURING COMPANY, INC.
PRINCETON, INDIANA

HANSEN REPRESENTATIVES:
THE FROMM COMPANY
5150 W. Madison, Chicago, Illinois
H. C. JOHNSON AGENCIES, INC.
Rochester, N. Y. — Buffalo, N. Y. — Syracuse, N. Y.
Binghamton, N. Y. — Schenectady, N. Y.
ELECTRIC MOTOR ENGINEERING, INC.
Los Angeles, Calif. — (OLive 1-3220)
Oakland, California
WINSLOW ELECTRIC CO.
New York, N.Y. — Essex, Conn. (SOuth 7-8229)
Philadelphia, Penn. Cleveland, Ohio

Sweet's Product Design File

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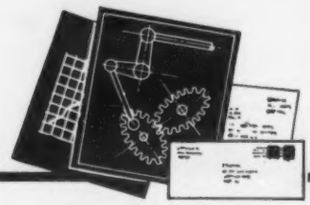
IDEA MART

DESIGN NEWS



Ideas described in this department are in varying stages of development. They are somewhere between initial conception and the prototype stage.

AVAILABLE

Mechanical Conversion Linkage

In the computing field there are many occasions to convert from digital input to a character output. At the present time, this is done mostly by an electronic conversion matrix. A much less expensive method is illustrated here and is available for purchase or licensing.

The principle of operation and the basic patentable feature are shown in Fig. 1. Using two solenoids as the motive power for each conversion linkage, the plungers are joined together with a link which is proportioned as shown by the formulas $h_1 = Ac/B$; $h_2 = 2Ac/A + B$. Each solenoid plunger has just two positions: energized and de-energized, corresponding to the energized and de-energized positions of each input line. As shown, this gives four exact positions for the end of the linkage corresponding to the two binary inputs. Figs. 2, 3 and 4 show how two sets of these linkages are used to position a slide for 16 different outputs for use with a projection-type character display unit having four input lines from the computer or digital voltmeter.

There are many uses for such a mechanism other than the display unit, such as the strip printer shown in Fig. 5. Since the solenoids have only two positions, the unit should stay in adjustment. Furthermore, in production it could be produced much cheaper than the conversion matrix alone. Write E. H. L., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.

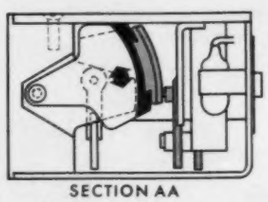
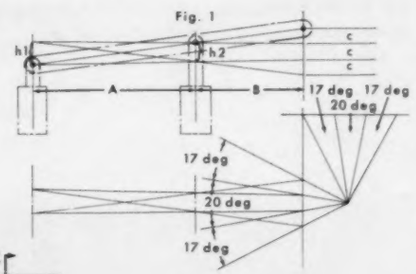


Fig. 4



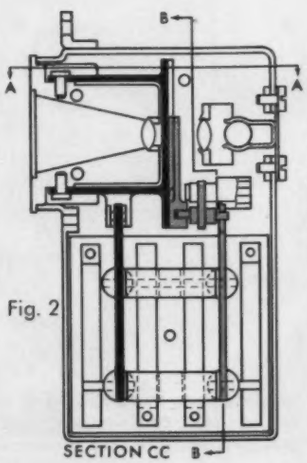


Fig. 2

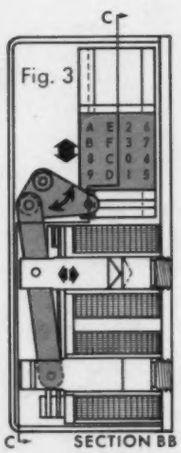


Fig. 3

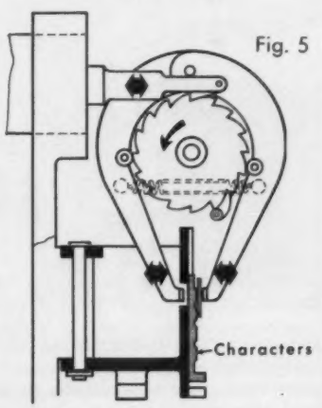
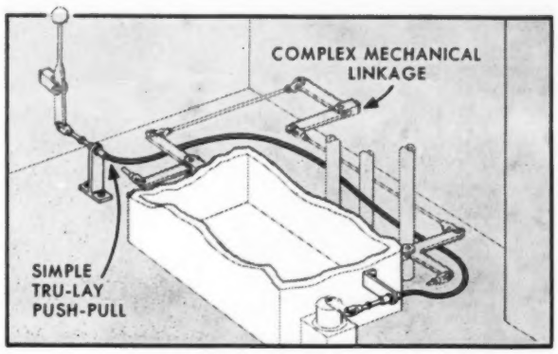


Fig. 5

TRU-LAY *PUSH*-PULL CONTROLS PROVIDE ACCURATE, DEPENDABLE REMOTE CONTROL FOR HUNDREDS OF PRODUCTS

• If your products involve remote control—electrical, hydraulic, pneumatic or direct—TRU-LAY PUSH-PULL FLEXIBLE CONTROLS can help solve your design problems. They provide positive remote control over long or short distances—up to 150 feet from the control point. Because they operate while flexing, they can snake around obstructions. They will not buckle. They are ruggedly constructed, easily installed and operated, sealed against dirt and moisture, and will handle jobs with as much as 1,000 lbs. input. PUSH-PULL CONTROLS are simple, have but one moving part, are noiseless, and give a lifetime of accuracy. Mechanical linkages, on the other hand, are complex. Unlike PUSH-PULL CONTROLS, they are made of many parts, wear at many points, and produce increased backlash, lost accuracy, and vibration rattles.



Sizes and Operating Heads to Fit Your Design

Control Dimension	Minimum Recommended Radius in Inches	Maximum Input Load in Pounds (Dependent on Travel)
3/32"	2	30
1/8"	3	65-125
3/16"	5	115-175
1/4"	6	300-600
5/16"	8	700-1,000

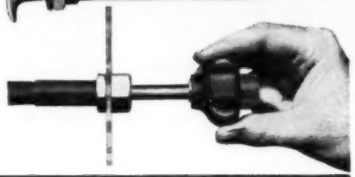
Heavy Duty • For use where rugged duty prevails, but where operation must be smooth and accurate. Meets all requirements for dependability and life.

Light Duty • Gives smooth, accurate and dependable performance at low cost. Available with your choice of several types of knobs.

Selective Friction • Amount of friction can be changed to meet individual requirements of the operator or application. Friction constant at any setting.

Position Lock • A slight turn of the T-type handle locks the control in any position. Available in two sizes for light and heavy-duty applications.

Micro Control • Push or pull the knob for instantaneous response, then rotate knob for vernier adjustment. Built for smooth, efficient operation on any job.



PUSH-PULL DATA FILE shows how to simplify, improve design

PUSH-PULL CONTROLS are solid as a rod and flexible as a wire rope. They're factory-lubricated for life, unaffected by temperature extremes, and can be adapted to practically any application. For complete details on how you can use them, write for the PUSH-PULL DATA FILE. It contains 7 engineering Bulletins which describe in detail the operation of PUSH-PULL CONTROLS, their applications, features and advantages. Our engineers will be glad to help you make TRU-LAY PUSH-PULL CONTROLS a part of your product.

PUSH-PULL CONTROLS

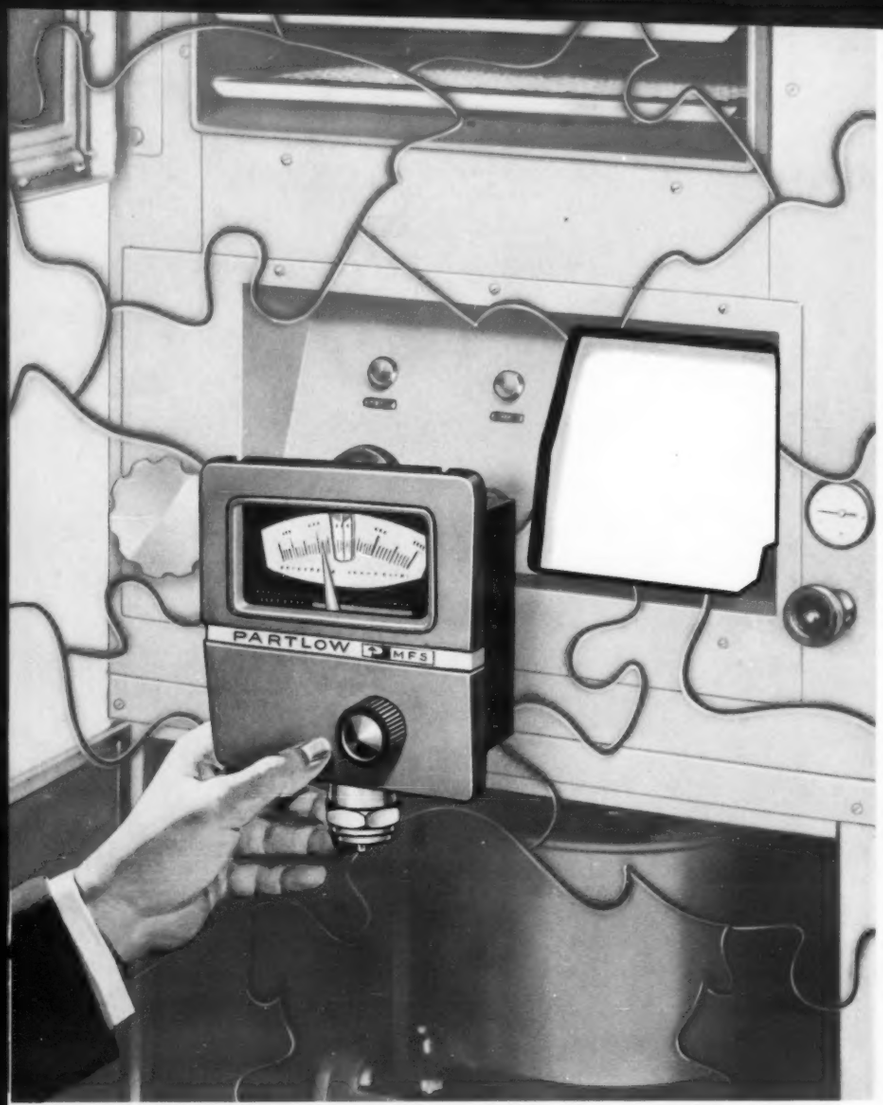
Automotive and Aircraft Division • American Chain & Cable Company, Inc.

601 B Stephenson Bldg., Detroit 2

2216-B South Garfield Ave., Los Angeles 22 • 929-B Connecticut Ave., Bridgeport 2, Conn.

Circle 32 on Reader-Service Card for more information

Circle 33 for more information on Partlow Products shown inside



Partlow makes 25 different indicating control models, including the handsome, high-visibility MFS shown here.

Partlow non-indicating controls give maximum dependability at minimum cost.

A Perfect Fit for Any Temperature Control Application!

Partlow temperature controls today function in an almost infinite range of industrial processes . . . Economically. Accurately. *Precisely!*

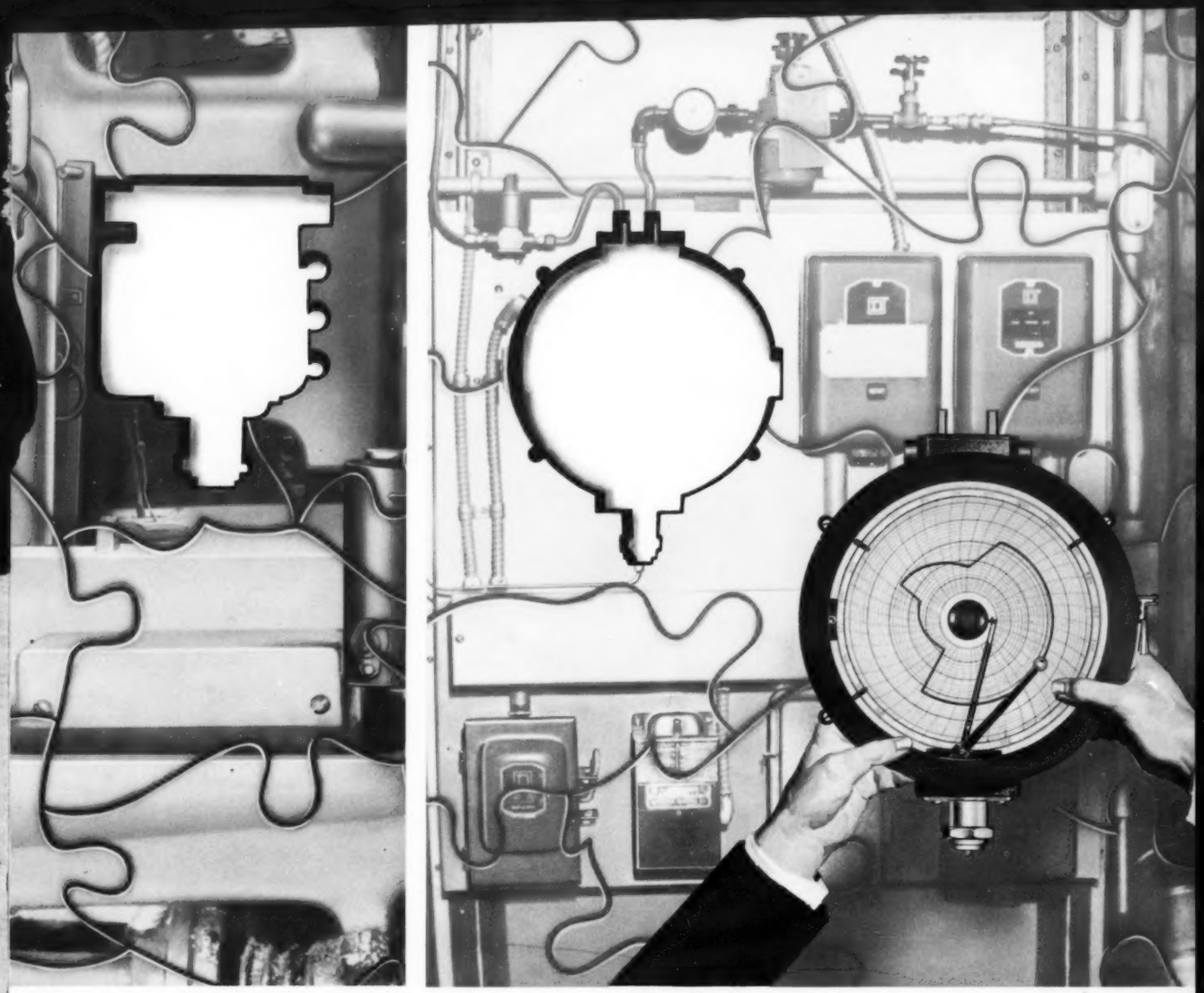
They can perform just as efficiently for *you*.

Partlow controls are actuated by the direct, positive power of mercury, require no mechanical or electronic amplification. Regardless of type, any Partlow you install will stand up to even extreme conditions of shock and vibration . . . without loss of accuracy or sensitivity.

And Partlow makes service headaches a thing of the past! All it takes to replace the Partlow thermal element is a wrench or screwdriver. No 'down time' necessary! The whole job can be done, right at the work site, in a matter of minutes.

If you need accurate, dependable temperature control anywhere within the −70° to 1100°F. range, you'll find a Partlow model to fit your requirements *exactly*.

Get full details without obligation. Fill out and mail the coupon now.



Versatile Partlow recording instruments keep rigid control of process temperatures, and prove it in writing.

Partlow makes the following types of controls and allied equipment for temperatures ranging from −70° F. to 1100° F.:

Electric
Mechanical
Pneumatic
Indicating
Non-Indicating
Recording
Explosion-Proof
Weather-Resistant
Limit
Program
Multi-Switch
Double Pen Recording
Process Timers
Safety Equipment
Thermometers
Control Accessories

41 Partlow Sales and Service Offices in Principal Cities of the United States, and the World.

World Export: Ad Auriema Inc., 85 Broad Street, New York 4, N.Y., U.S.A.

PARTLOW
TEMPERATURE CONTROLS

THE PARTLOW CORPORATION

New Hartford, N.Y., Dept. B

Please send condensed Catalog of Partlow temperature controls and allied equipment for industrial heating and refrigeration.

Name and Title.....

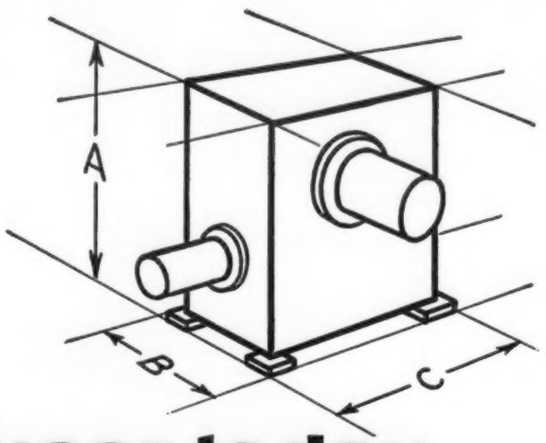
Company.....

Address.....

City and State.....

.....

Do-It-Yourself...



Let's design a speed reducer today

So you can't find a speed reducer to fit your latest brainchild without ruining the design? Doggone manufacturers all build reducers too big to fit into those few cubic feet you've got left for the reduction unit back behind the double-ended dingbat?

Revolt! Design your own! Show 'em!

By George, design it yourself and it'll fit. How? Well, you know your size limits. Draw the biggest box that'll fit the space and you've got your reducer housing specifications.

Now you need gears that will (1) transmit the needed horsepower under all operating conditions, (2) provide the ratio your machine requires and (3) fit the space that's available. You'll soon discover that there are limits to what gears can do in transmitting horsepower. The cheapest answer is parallel shaft helical gears. If they'll fit you're in clover. But they take the most room, especially when you're out of the fractional hp range. The right angle worm and gear combination is the most compact drive arrangement.

Here again you have a choice. Cylindrical worm gearing is often used, and if it'll do the job, is worth consideration. But it's not the most compact possibility. The best way to shrink gears and still carry the load is the double-enveloping worm gear design. Both worm and gear are throated and the two literally wrap around each other. This brings center distance of the two shafts closer together and you can put them inside smaller housings.

Does this reduce load capacity? No sir! You can carry the same load with center distances up to 33% smaller than those of cylindrical worm gears. Or use the same center distance and carry a greater load. Will these gears hold up in operation? Sure, if you beef up the teeth, the bearings and the housing. Use straight-sided worm and gear teeth and you'll get all the strength there you'll ever need. Use large taper roller bearings with real B-10 life. Use a reinforced, heavy wall housing that won't distort under load. Put fins on it for added cooling and increased thermal horsepower capacity to meet your needs. Now, put the whole thing together and you've got a speed reducer that's a dilly.

Designing your own speed reducer give you a headache? Looking for an easier way? There is one. Someone's already done exactly what you're talking about. You can order that compact speed reducer right off the shelf. Where?

Cone-Drive Gears, that's where!

Yes sir. They stock double-enveloping worm gear speed reducers from fractional to 665 hp. Standard ratios from 5:1 to 70:1 in about 15 increments, all interchangeable in any type housing of a given center distance. Worms over and worms under. Gear shafts vertical, too. Single- or double-extended output shafts, or shaft mounted. Over 200,000 combinations possible. Wow! Just about anything you want.

Better get Cone-Drive's new speed reducer catalog that details everything. Ask for Bulletin CD-218. Cone-Drive Gears, Div. Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Circle 34 on Reader-Service Card for more information

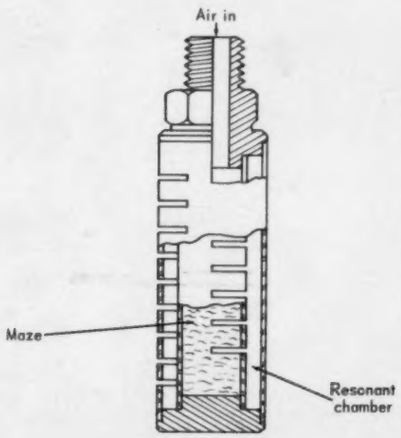
Circle 33 for more information on Partlow Products shown inside

AVAILABLE

Air Muffler

This is an inexpensive air muffler for use where exhaust air noise must be decreased to a minimum with a minimum of back pressure. The unit may be used for muffling the exhaust noise from air cylinders, valves and similar equipment.

Engineering has been completed and samples built and tested for ⅛-, ¼-, ⅜- and ½-inch NPT sizes. Wish to sell or license engineering, test data or make the manufacture for a reputable sales outlet. Write W. D. G., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.



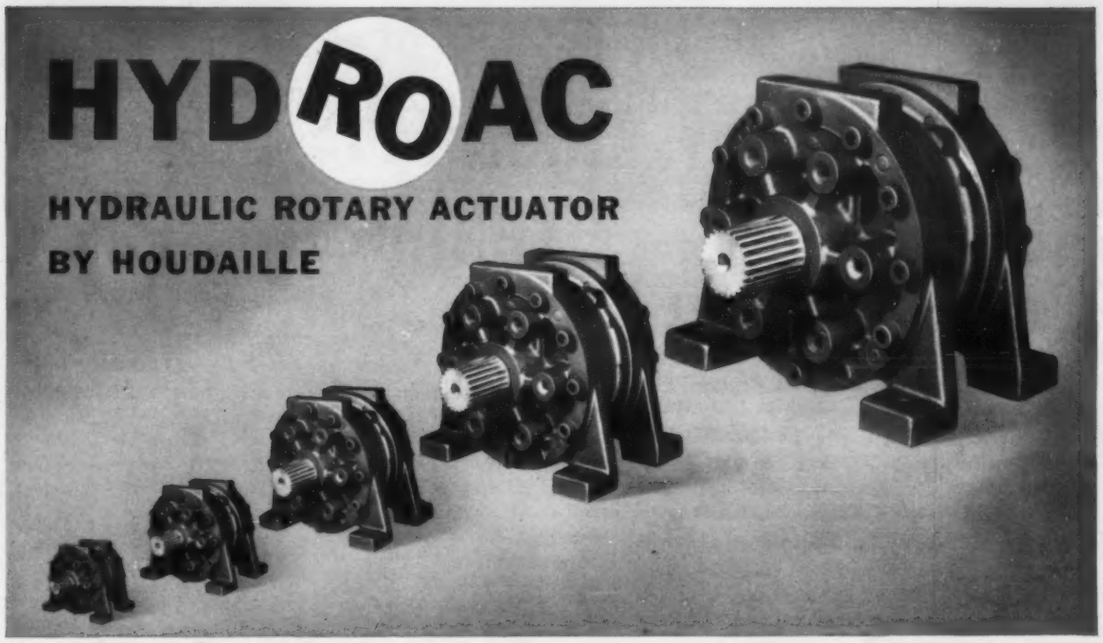
Flashing Light Circuit

I have available for purchase the rights to a pending patent application on a simple automotive circuit for flashing both brake lights simultaneously while backing up. This provides a visual backup warning signal to pedestrians and to approaching vehicles. Flashing of both red lights occurs as soon as the gear shift lever is moved to "reverse" with ignition "on" and is independent of operation of the brake pedal.

The system can be added very simply to existing passenger and truck vehicles. The circuitry has two forms. In one form, a single relay operated by a conventional backup light switch does all the work. In the other form, the backup light switch is provided with one additional set of contacts.

The system also may be used as a warning signal for a disabled vehicle. When used in this manner, a simple toggle switch is added to bypass the ignition switch and enable the flashing lights to be used as a warning even though the ignition is "off" at the time.

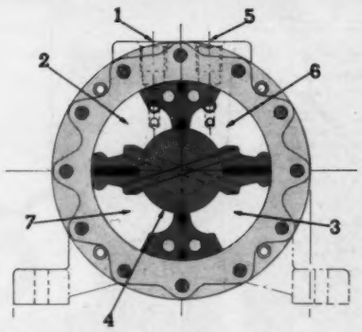
Circuit drawings and information regarding the extent of patent coverage already allowed are available upon request. Write W. W., Idea Mart, DESIGN NEWS, 20 N. Wacker Dr., Chicago 6, Ill.



NOW, AVAILABLE IN 5 STANDARD SIZES!

Each size, from the "Tiny" 4.75″ diameter HydRoAc unit to the "Giant" 20″ diameter unit, can be supplied in two lengths, in single and double-vane configuration, and with three different types of bearings. Provision is made for foot or end mounting.

The most effective way to convert hydraulic power into rotary motion, Houdaille HydRoAc units achieve an efficiency of 95 per cent or over. They provide torque from 1500 inch-pounds to 741,000 inch-pounds at 3000 p.s.i., and the operating pressure range extends down to 250 p.s.i. Angular travel is up to 280° for a single-vane unit.



Here's how HydRoAc works

When high pressure fluid enters the port (1) connected to chamber (2), it will cause this chamber, and chamber (3) which is connected by internal porting, to increase in volume. The other pair of chambers, connected to the discharge port, will reduce in volume. This rotates the wingshaft (4) in a counterclockwise direction. Snubbing occurs at the ends of angular travel as the rotating wingshaft vane closes off the discharge port (5) and traps a small amount of fluid in chambers (6) and (7). Rotation in the opposite direction is obtained by reversing hydraulic pressure. Full speed response from the snubbed position is obtained through a check valve.

Send this coupon for more information on Houdaille's HydRoAc

APPLICATIONS UNLIMITED

Tooling	Indexing Devices
Roll Jigs	Rotary Drilling Machines
Fork Lift Trucks	Sawmill Machinery
Printing Presses	Drive Mechanisms
Conveyors	Die Clamps
Automatic Turret Lathes	...plus many others

Name *Address*

City *Zone* *State*

... Specialists in rotary type hydraulic equipment

Houdaille Industries, Inc.

Buffalo Hydraulics Division • Dept. A • 537 E. Delevan Avenue, Buffalo 11, N. Y.

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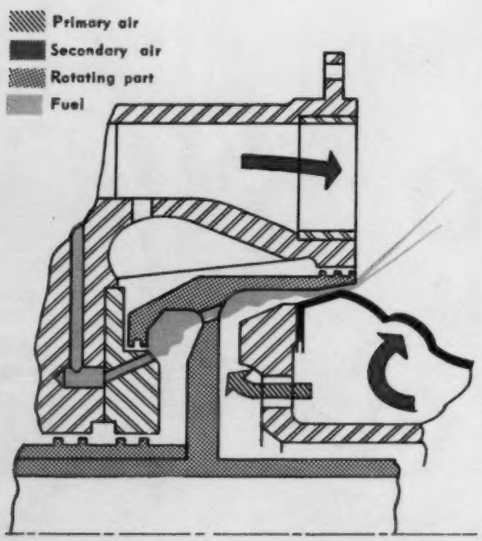
Burner for Gas Turbines

French Patent 1,227,233; VEB Entwicklungsbau Pirna, East Germany.

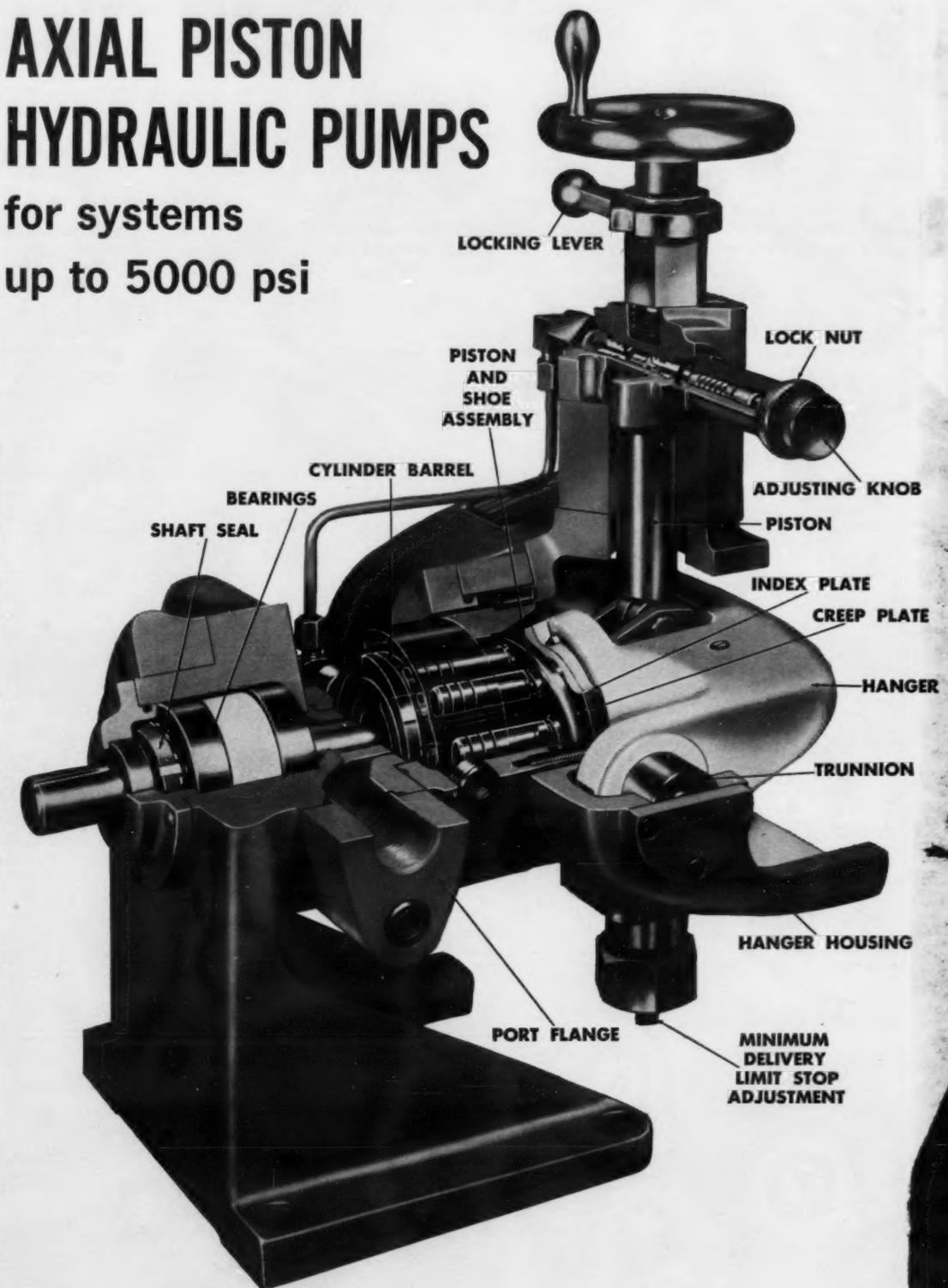
This patent describes a high-speed rotary burner head for gas turbines. The design is compact and of high efficiency. Fuel is injected into an annular cavity in the rotor, which turns at high speed. A thin film of fuel is formed on the surface of this cavity. From there it leaks through channels into the primary air flow. Primary air is fed through a stator configuration, giving high-speed flow at the mixing stage. Secondary air is fed to



the combustion chamber through an exterior annular conduit and through other holes in the axial air supply part. Labyrinths seal the rotating burner.

This injectorless burner design is said to result in lower material costs. Ordinary low-pressure fuel pumps can be utilized. An important feature is the small axial distance occupied by the burner head.

Design of variable volume
AXIAL PISTON
HYDRAULIC PUMPS
for systems
up to 5000 psi



By: Ellis H. Born

Director of Sales-Engineering
Denison Engineering Division
American Brake Shoe Co.
Columbus, Ohio

With today's ever-increasing requirements in the transmission of higher horsepower, the designer must look to hydraulic components that will give the greatest transmission efficiency with the lowest possible cost and the smallest possible package. With smaller, lighter, more powerful equipment—operating pressures of 2000, 3000 and 5000 psi are becoming commonplace. To meet the needs of higher pressures with a high degree of reliability, axial piston pumps and motors of proper design should be considered.

For 5000 psi requirements, the axial piston pump (illustrated) is a logical choice. It operates on the principle of a series of pistons in a common barrel that progressively draw oil into the barrel on the suction stroke and force oil from the barrel into the line on the discharge stroke.

With this simple axial piston design, direct and unrestricted flow into the pumping assembly is possible, eliminating the need for the large flow areas used and the moving seals which, in turn, eliminates maintenance. Direct flow path further insures good suction characteristics—a highly desirable operating advantage for obtaining efficient hydraulic performance.

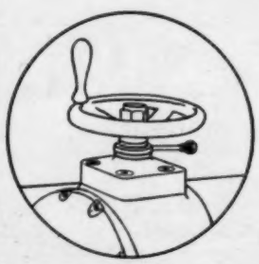
The port plate of the Denison pump is designed as an axial hydrostatic bearing which balances out the thrust of the cylinder barrel, leaving only sufficient force to create a positive seal contact between the cylinder port plate and the cylinder barrel. Because of reduced thrust, wear on mating surfaces is decreased and pump life is greatly extended at all pressures up to 5000 psi.

Where variable volume is required, it is logically desirable (for efficiency, simplicity and low maintenance) to eliminate the need for varying the position or angle of the cylinder barrel to regulate volume. In the Denison axial piston pump, output up to 125 gpm is simply regulated by varying cam plate angle. Zero to full flow or flow reversal is regulated by handwheel, hydraulic cylinder, stem, electric motor, compensator or electrohydraulically.

In the Denison design, the line of action of the combined radial load of all pistons is through the roller bearing supporting the cylinder barrel. The use of a large bearing provides non-deflecting support for these radial forces. As a result, unbalanced or twisting offset that would tend to unseat the cylinder barrel from the port plate is eliminated. A continuous, effective sealing action of the barrel against the port plate is maintained to promote high pumping efficiency.

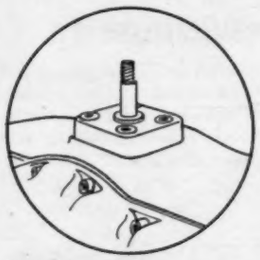
Piston and shoe assembly design also reduces by one-half the number of ball and socket couplings found in other types of axial piston pump construction. The shoes hydraulically balance out all piston thrust, eliminating need for thrust bearings.

Data and specifications on 5000 psi pumps, motors and controls are available from your Denison representative—located in principal cities—to assist you in developing hydraulic systems for maximum efficiency and economy.

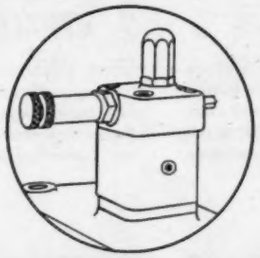


HANDWHEEL CONTROL
...with locking device for accurate manual pump volume regulation.

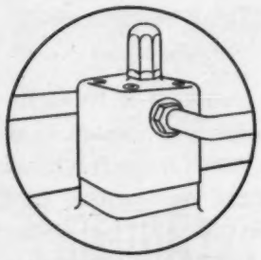
ELECTRIC MOTOR CONTROL
...adjusts pump volume to desired level. Integral brake in gear-head motor eliminates over-travel.



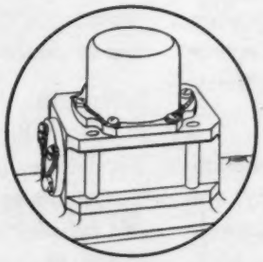
STEM CONTROL
...provides mechanical linkage to the driven equipment.



PRESSURE COMPENSATOR CONTROL
...affords automatic regulation of pump volume to meet preset pressure demands.



HYDRAULIC CYLINDER CONTROL
...similar to stem control, except volume is hydraulically regulated.



ELECTRO-HYDRAULIC CONTROL
...utilizes sensitive, system error-detecting unit which energizes hydraulic volume control piston.

NEW CATALOG FOR DESIGNERS AND ENGINEERS

Write for your copy of Bulletin 220—"Hydraulic power to 5000 psi". Includes complete specifications, operating data and applications for Denison's full line of hydraulic pumps, motors and controls.

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1190 Dublin Road • Columbus 16, Ohio

Diaphragm Pump

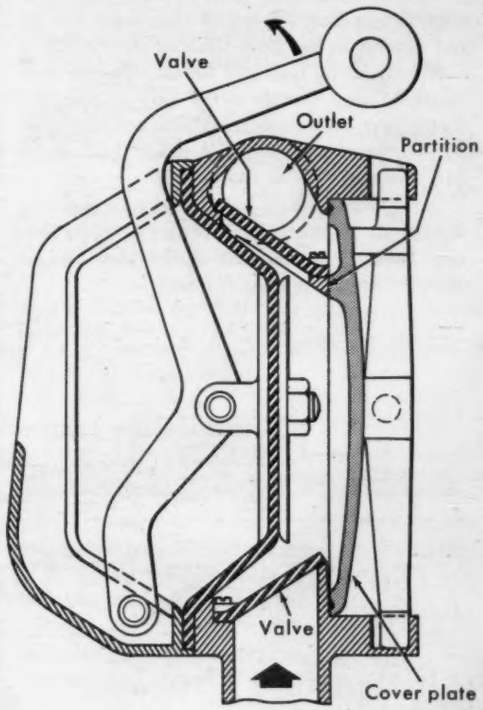
British Patent 845,100; William Michael Henderson, 16 Vicarage Lane, Laleham-on-Thames, Middlesex, England.

This invention covers a simple diaphragm-type pump, easily opened for cleaning. The pump body is cylindrical, its bore being several times its length to achieve high output.

A non-return inlet valve consisting of a rubber flap seating against an inclined mouth terminates the inlet pipe. Diametrically opposite is an outlet chamber, separated from the pumping chamber by a port spanned by another rubber flap valve acting as non-return outlet valve.

One end of the housing is closed by a rubber diaphragm, clamped around its periphery. The clamp is slotted to permit movement of the pump-lever, pivoted between a pair of flanges. This lever also pivots on two clamping plates that grip the diaphragm, one on each side.

A removable cover plate seals the other end of the housing, and is pressed against it by two cams. The cams are operated by a handle on a shaft loosely journaled in lugs on the body. As a result of design, the pumping and outlet chambers are opened and both sides of the outlet valve are exposed for cleaning when cover plate is removed.



Circle 36 on Reader-Service Card for more information

Swivel Joint for Extreme Pressure, Temperature Ranges

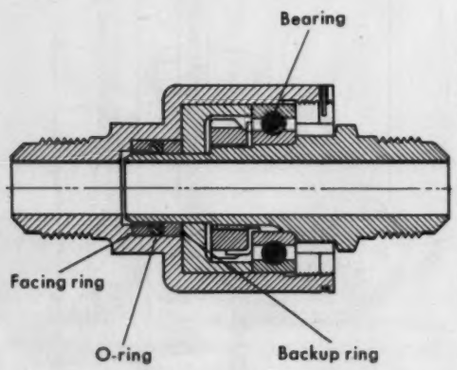
U. S. Patent 2,963,304; Harold Comlossy, Jr., and Robert R. Hedden, assignors to The Youngstown Sheet and Tube Co., Youngstown, Ohio.

A deformable backup ring and O-ring provide this swivel connector with extreme pressure and temperature range characteristics. The backup ring prevents extrusion of the rubbery material of the O-ring, even under extremely high pressures.

An inner tubular portion is supported within an outer tubular part by a combined radial and thrust-type bearing. Rotation and limited axial relative movement are possible. The inner tubular part has a cylindrical stem which projects into the tubular wall of the outer member. An annular chamber is thus formed between the two parts. In the center of the chamber is an O-ring whose internal diameter corresponds to the external diameter of the stem and whose external diameter corresponds to the diameter of the inwardly facing outer wall. A tubular backup ring is positioned between the O-ring and a shell or annular spacer member. One side of the backup ring is formed as an arc to conform to the O-ring. The arc is slightly less than 180 deg so that sharp lips do not extend to the centerline of the O-ring.

A facing ring is placed on the opposite side of the O-ring. Similar to the backup ring, the facing ring has a slightly larger inside diameter to provide a space through which fluid under pressure may flow to the O-ring.

The backup ring is composed of a material having an extremely low coefficient of friction and which is deformable under heat and/or pressure to compensate for wear.



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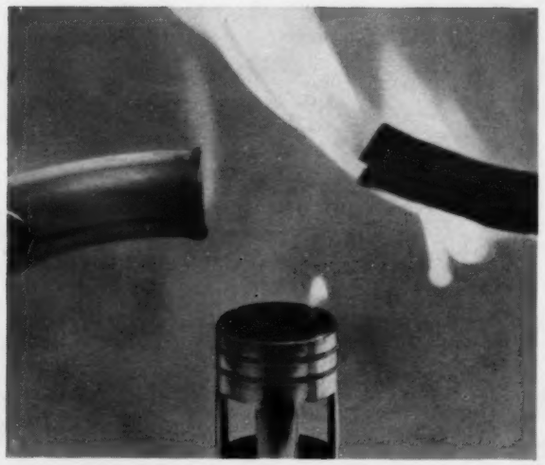
Versatile Du Pont Elastomer Assures Greater Reliability,

1. HYPALON Is Ozone-Proof

No other rubber can match it. Drain hoses above were exposed simultaneously to 15 PPM ozone for more than 5 hours under lab test conditions. Ordinary rubber hose (bottom) developed severe cracks, split when bent. HYPALON-veneered hose (top) remained tough, lively, *crack-free.*



2. HYPALON Is Flame-Resistant

Gives appliances an important safety bonus because it will not support combustion. In a test exposure to open flame, HYPALON door seal (left) extinguished itself as soon as flame was removed. Seal made of ordinary synthetic rubber, however, continued burning.

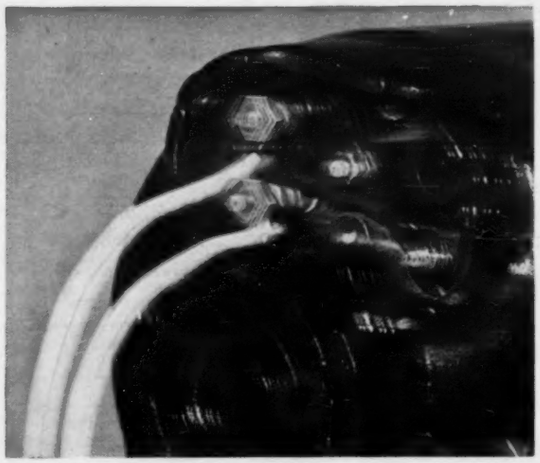
HYPALON's outstanding combination of properties—not offered by *any* conventional synthetic rubber—makes it an ideal material for "service free" appliance design. HYPALON has proven especially successful in applications where severe operating conditions shorten the life of ordinary rubber parts.

Exceptional resistance to ozone, flame, abrasion and chemicals, plus *permanent* colorability, are just a few of the reasons why HYPALON is specified for key resilient components by many leading appliance manufacturers. There are others—such as excellent resistance to temperature extremes and good electrical characteristics. HYPALON is currently lengthening the life of such parts as bleach tubing, drain hose, seals, gaskets, electrical wire and other resilient molded and extruded parts.

Investigate the design advantages of HYPALON in the appliances *you* design and manufacture. For detailed information, send for our free booklet discussing properties and applications. Clip and mail the handy coupon today. Or just write: E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department DN-2, Wilmington 98, Delaware.

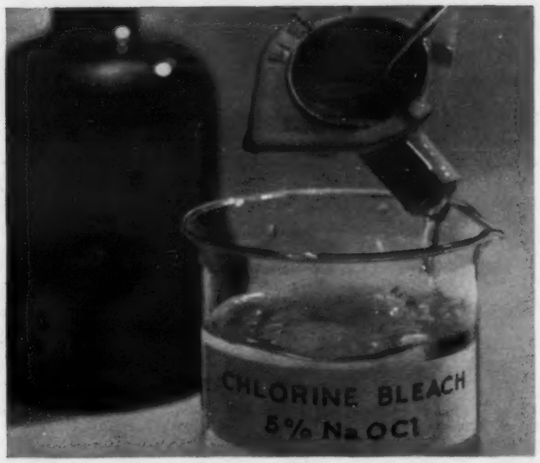
HYPALON® CAN SERVICE INTO APPLIANCES

Prevents Breakdown of Key Resilient Parts. Here's Why:



3. *HYPALON Is Durable*

Parts stay tough and lively, afford long, reliable service because of excellent resistance to abrasion, flex-cracking, extremes of temperature. HYPALON is ideal for lead wires on motors and compressors where exposure to constant vibration, ozone, heat, oil and grease is common.



4. *HYPALON Resists Oils and Chemicals*

Outstanding resistance to strong oxidizing chemicals suits HYPALON for prolonged contact with concentrated bleach solutions. HYPALON resists dyes, wet steam, household ammonia, detergent-laden wash water . . . performs well in contact with food chemicals, lubricating oils, many solvents.

AND . . . HYPALON Is Color Stable

Can be compounded in white and an unlimited array of bright and pastel shades to complement appliance styling, enhance sales appeal. Colors are stable and durable, stay bright and fresh. Even weather and sunlight won't cause them to fade or darken.

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SYNTHETIC RUBBER

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Wilmington 98, Delaware

Please send me, without obligation, more information on Du Pont HYPALON synthetic rubber.

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Firm_____

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City_____ Zone____ State_____

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The following list compiled from recent issues of the Patent Gazette gives you increased coverage of new patents whose details may be useful to product and machine designers. Copies may be obtained from the U. S. Commissioner of Patents, Washington, D. C. The price is 25c each.

SPINDLE COUPLING DEVICES FOR ROTARY MEMBERS
U S Patent 2,968,936; L. P. Croset, Huddersfield, England.

CENTRIFUGAL GOVERNORS
U S Patent 2,968,951; Robert Gautheir, assignor to Societe Industrielle Generale de Mecanique Appliquee S.I.G.M.A., Paris, France.

DRIVE WITH ANTI-BACKLASH MEANS
U S Patent 2,968,975; Fred R. Swanson and Carl F. Erikson, assignors to Sundstrand Corp., Rockford, Ill.

POWER CONTROL APPARATUS
U S Patent 2,969,043; Wilmer J. Friesen, Hutchinson, Kan.

VARIABLE CAM TIMING MECHANISM
U S Patent 2,969,051; Philip S. Webster, Painesville, Ohio.

CONTROL VALVE
U S Patent 2,969,089; Charles A. L. Ruhl and Robert C. Westveer, assignors to The New York Air Brake Co., New York, N. Y.

TORQUE-LIMITING DEVICES
U S Patent 2,969,132; Harold H. Stewart, Dallas, Tex.

OVERLOAD CLUTCH
U S Patent 2,969,133; Richard Langheck, assignor to Wilhelm Sihn, Jr., K.G., Niefern, Baden, Germany.

NO-BACK ARRANGEMENT FOR BALL SCREWS
U S Patent 2,969,222; Richard E. Sears, assignor to Beaver Precision Products, Inc., Clawson, Mich.

TEMPERATURE-RESPONSIVE CONTROL APPARATUS
U S Patent 2,969,224; Russell B. Matthews, assignor to Baso Inc., Milwaukee, Wis.

VEHICLE SPRING DEVICE
U S Patent 2,969,230; William A. Scheublein, Jr., and Edmund A. Check, assignors to Moog Industries, Inc., St. Louis, Mo.

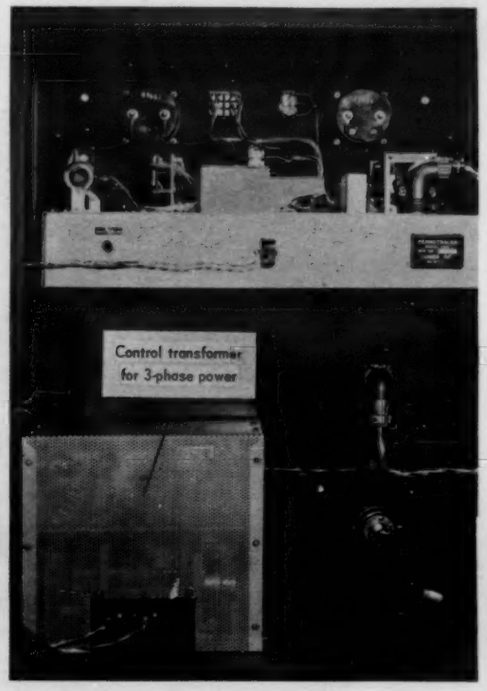
LUBRICATED ANTI-FRICTION BEARINGS
U S Patent 2,969,264; Edward R. Lamson, Sewell, N. J., and Martin J. Devine, Havertown, Pa.

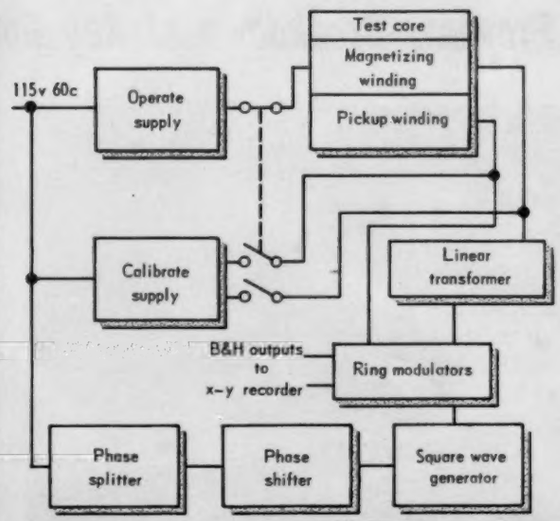
MAGNET-OPERATED SWITCH
U S Patent 2,969,445; Clarence W. Mitchell, assignor to William T. Sevald, Royal Oak, Mich.

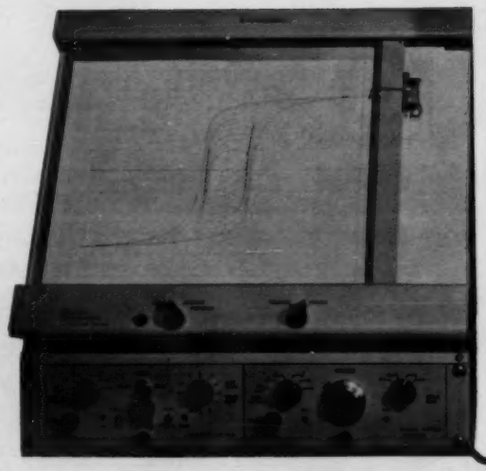
DESIGN IDEAS NEWS

Portable 'Ferrotracer' Generates Own Three-Phase Power

Lars G. Soderholm, Midwest Editor







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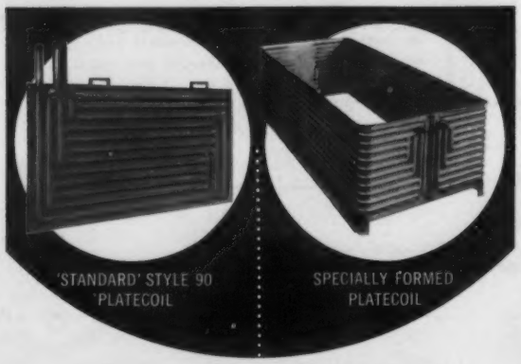

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WRITE FOR NEW BULLETIN P51

PLATECOIL DIVISION, TRANTER MANUFACTURING, inc.
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FREE SAMPLES!

Hi WIRE CONNECTORS

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SPECIFY TYPE AND GIVE WIRE COMBINATIONS

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The latest model of the "Ferrotracer", an instrument that traces dynamic hysteresis loops of magnetic materials, generates its own three-phase power through the use of phase-splitting circuits. A built-in calibrating source traces two reference lines on the plot of a core which represents the B and H axes of the dynamic loop.

This unit is used to test toroidal cores and to get information about the magnetic properties of core materials under varying conditions. Previous units required three-phase power which limited the places where they could be used. The new unit can be located remotely from the core under test for environmental studies. It also contains a built-in calibration source. The graph paper being used in plotting the hysteresis loop can be matched so units on the H-axis correspond to a certain number of oersteds while units on the B-axis correspond to a prédetermined number of gausses.

The "Ferrotracer" traces dynamic B-H loops through the use of drift-compensated, silicon-diode chopper circuits. The phase-sensitive rectifier circuits are operated from a magnetic switch. This method of B-H loop tracing eliminated the need of working only at low frequencies, necessary with mechanical rectifiers.

To operate this unit, magnetizing turns and pick-up turns must be wound about the core to be tested. Two or three magnetizing and six or seven pickup turns are usually adequate. Excitation power is then turned on and adjusted. The x-y recorder sensitivity is increased until the B-H loop is apparent and of sufficient amplitude. Depending on the degree of saturation of the core desired, the magnetizing current can be adjusted. One minute is required to trace a complete B-H loop regardless of settings on the "Ferrotracer" or x-y recorder.

In calibration, the B-switch replaces induced voltage from the flux winding of the test core by a known voltage from the calibration circuit. This voltage is used to calculate flux density of the hysteresis loop. The H-switch permits a current output which matches magnetic field intensity to be read on the voltmeter. The voltmeter is connected across a precision 1-ohm, 50w resistor and acts as an ammeter. Maximum magnetic field intensity is calculated from the current measured by a rectified average-reading voltmeter.

Model 2158 "Ferrotracer" is made by Lumen, Inc., Joliet, Ill.

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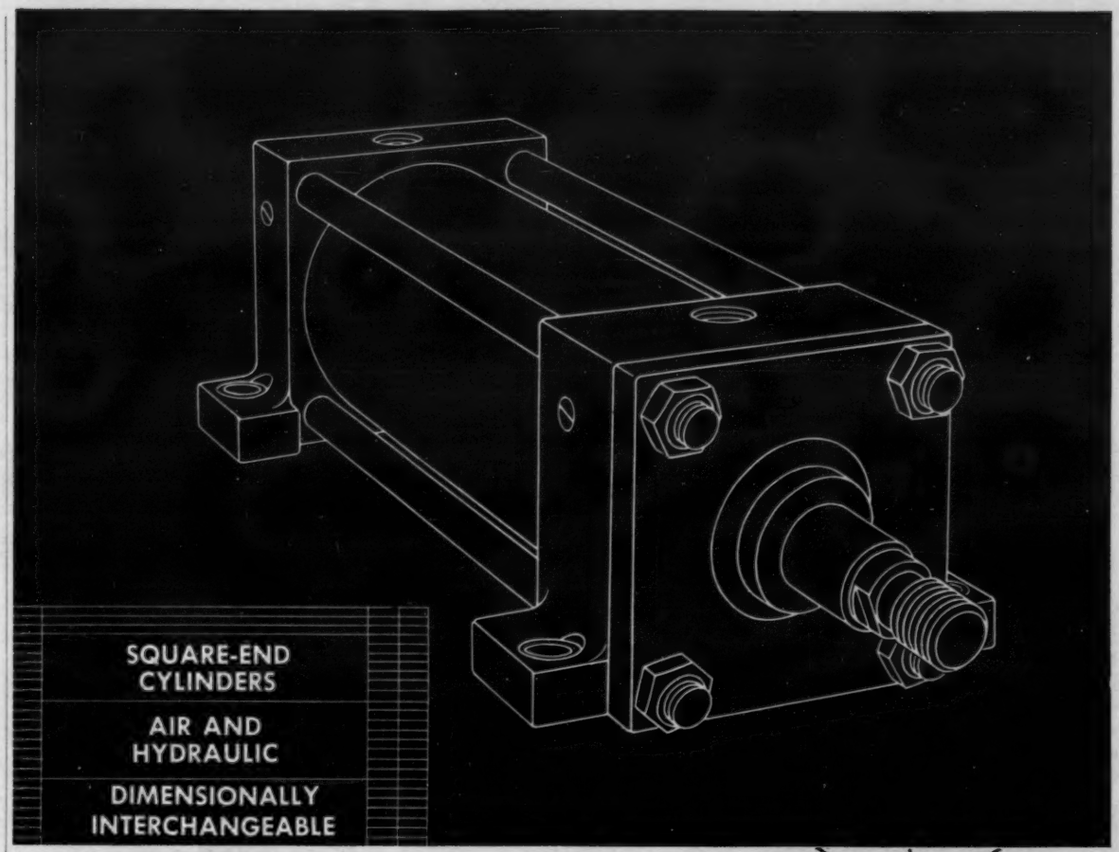
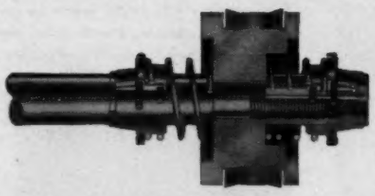


How MEAD takes the BUMP out of high-speed pistons



FULL FLOATING CUSHIONS

Detail shows two-stage feature of full floating cushion on a piston used for hydraulic pressures over 250 psi. MEAD Square-End Cylinders also offer these other design advantages:

- Seamless, hard drawn, micro-finish brass barrel for long piston seal life
- Cold drawn steel cylinder heads with all surfaces permeated with black oxide for rust resistance
- High tensile chrome plated steel piston rods
- Accurately machined rod bearing cartridge made of solid bearing bronze

Special *full floating cushions* in new MEAD Square-End Cylinders are uniquely mounted on springs rather than on solid studs. The result is a smooth, high-speed piston advance without the use of ball checks. In hydraulic units, the two-stage design of the floating cushions completely eliminates bumping. Fully adjustable from the slightest measurable cushioning effect to complete stoppage, the full floating feature also reduces cushion wear caused by impurities in the working medium. In air models up to 250 PSI and hydraulic units up to 1000 PSI, MEAD Square-End Cylinders are available in a full range of bore, stroke and piston sizes. Complete selection of mounting styles. All units are dimensionally interchangeable and conform to JIC specifications. For consultation and information on quick delivery and competitive prices, write to MEAD *today*.

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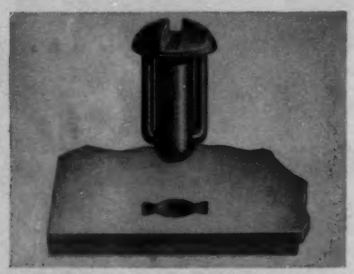
ANSWERS to specific fastening problems ...by SIMMONS

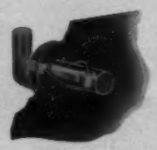
Economy, design flexibility, quick and easy installation, strength, and smooth, dependable action are advantages of these Simmons Fasteners, made for a variety of special applications. Whatever your fastening problem, engineering aid is available from Simmons.

HOOK-LOCK—Springless, positive-locking latch which lies flat against mounting surface, open or closed. Provides high closing pressure and load-carrying capacity. For military as well as commercial container applications.

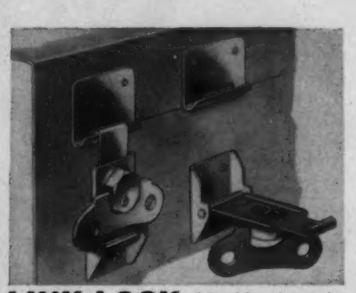


SPRING-LOCK—Perfect, proved blind rivet for removable covers and panels on electric and electronic equipment, sheet-metal automobile parts, appliances.

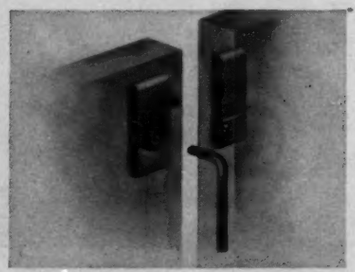
Plastic Spring-Lock Shelf Supports with "heart of steel" help refrigerator makers cut costs, speed production, simplify servicing.



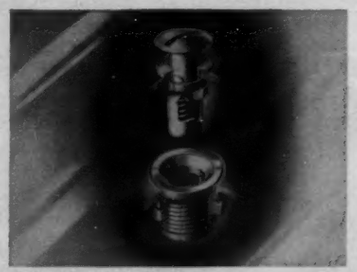
SEND TODAY for your copy of the Simmons catalog, with specifications, applications, installation instructions for all Simmons Fasteners. Samples are available. For special assistance, describe your requirements.



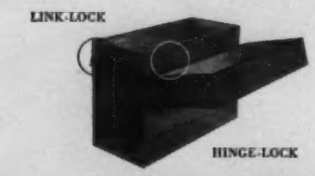
LINK-LOCK—Ideal latching device where heavy locking pressure is necessary. Available in heavy, medium, light duty, for use in military and commercial containers and demountable construction.

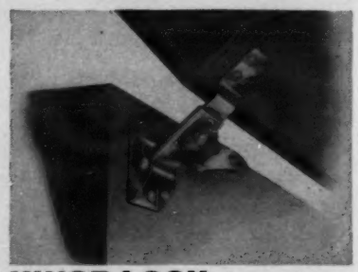


DUAL-LOCK—Impact and vibration-proof high-load butt-joint fastener that will not accidentally unlock or loosen. Recess in panels or surface mount. Withstands 7000-lb. tension.

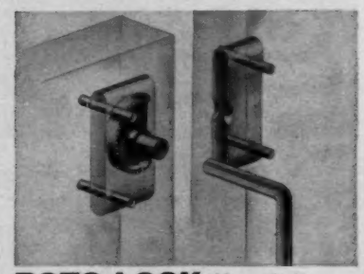


QUICK-LOCK—For assembling removable panels and access doors. Locked by a 90° turn. Various sizes and types, for weather-tight electrical units, cowlings, access panels.

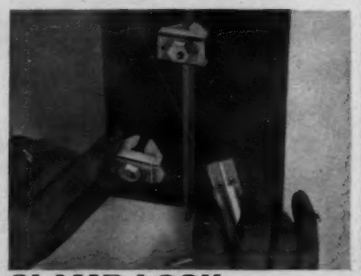




HINGE-LOCK—A rugged pressure hinge which provides a strong seal along the hinge line of gasketed equipment containers and transit cases. Matched hardware with LINK-LOCK.



ROTO-LOCK—Versatile fastener for butt or right-angle joints in portable shelters, partitions, knock-down shipping boxes, etc. Solidly built, springless.



CLAMP-LOCK—A simple and strong, positive-locking clamp for fast assembly (and disassembly) of permanent or temporary rooms and buildings of flanged-panel construction.

SIMMONS FASTENER CORPORATION

1762 North Broadway, Albany 1, New York

Circle 41 on Reader-Service Card for more information

IDEAS . . .

ELECTRICAL DEVICES

Card Reader Switches

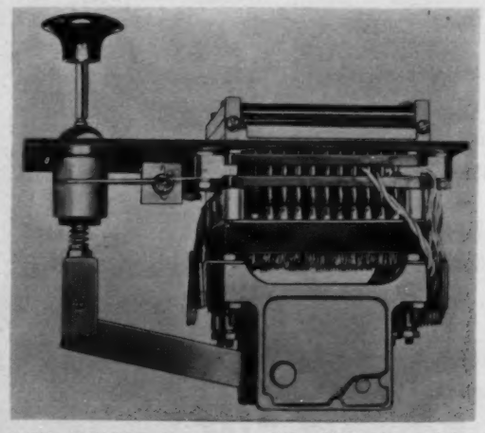
E. J. Stefanides, Central States Editor

Basing the design of a punched card reader on the principle that the absence of a hole in the card actuates the switch contact has resulted in a number of important operating advantages. It allows the use of more rugged switching and actuating mechanisms, making possible the use of heavy contact pressure with resulting low contact resistance. It also allows the switch elements to be of relatively high current-carrying capacity. "Absence of hole" actuation also provides a safety feature which prevents possibility of overloading circuits by accidentally tripping the device without a card in place.

The card reader consists of a heavy cast frame on which the plastic top and bottom contact decks of the 186 individual switches are mounted. Circuits are made and broken by floating pins which move up and down inside tubular spring contacts. The pins are in turn mounted in a lifter plate assembly which is also plastic.

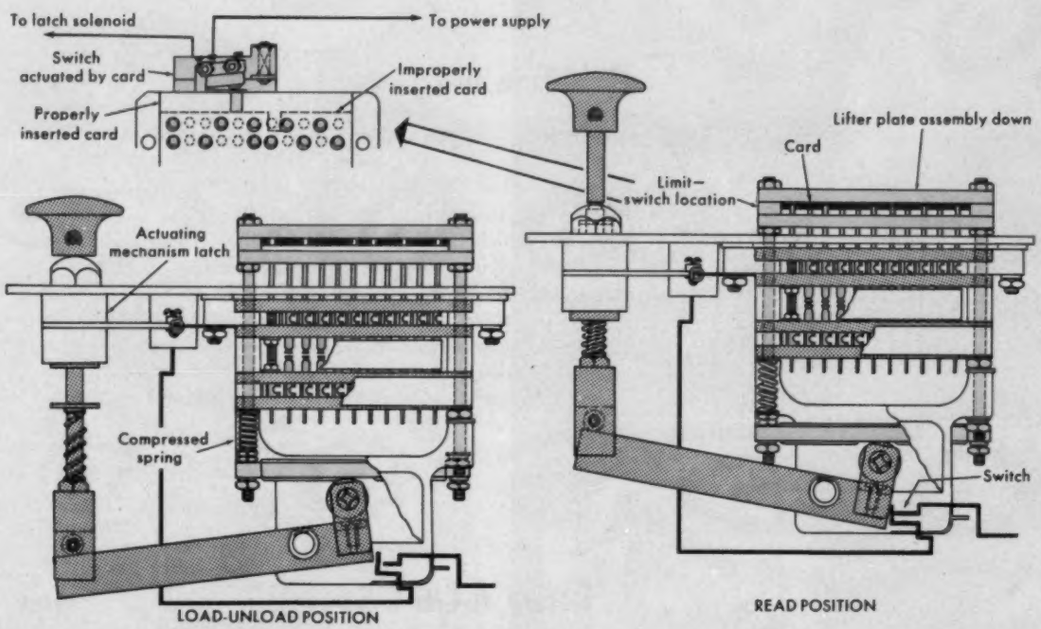
This device was designed originally for incorporation in a line of semi-automatic tube testers It is now available as a component for automatic industrial multiswitching applications.

It was designed and is manufactured by the Hickok Electrical Instrument Co., Cleveland, Ohio.

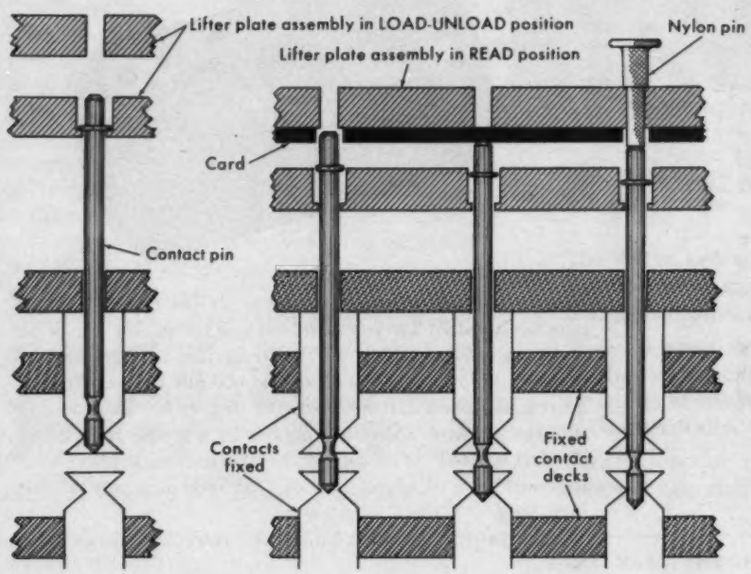


CARD READER incorporates 186 self-cleaning, wiping-type switches. Up to 60 circuits may be energized at one time, providing up to 12.6 by 10^{56} switching combinations. Design permits low contact-to-contact resistance of 0.005 ohm and moderately high current-carrying capacity of 10 amps.

Are Actuated by Absence of Hole in Card



CARD IS INSERTED into lifter plate slot, tripping switch which energizes unlatching solenoid. Springs force lifter plate assembly downward. At end of stroke, second switch is contacted, closing circuit. Contact pins are forced down into lower deck contacts by card, closing circuits where holes do not occur in card. Depression knob lifts plate assembly for card removal and disengages contact pins from lower contacts, opening circuits. Notch in card must line up with stop on lifter plate to trip switch, providing simple safety feature.



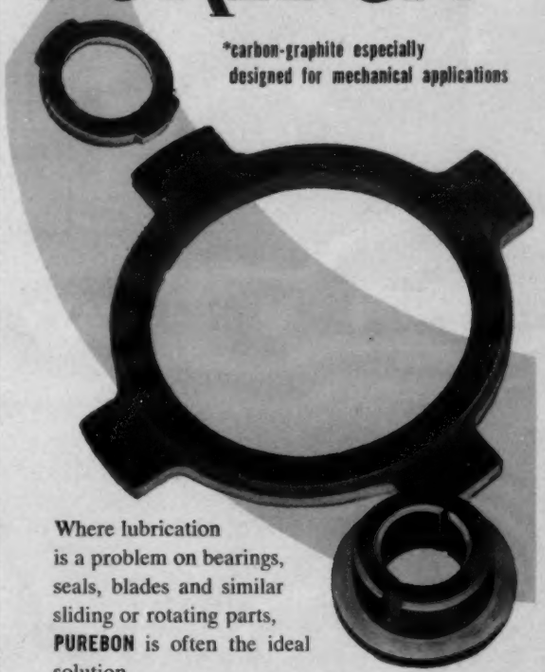
PIN - ACTUATED SELF - WIPING SWITCH DESIGN allows four conditions of switch operation. With lifter plate assembly up, all pins are held up, opening all circuits. With lifter plate down (in "read" position), absence of hole in card forces pin downward, closing individual circuit. When switch is in read position, nylon pin can be inserted through top deck and hole in card to provide pegboard or manual actuation of circuits.

DO YOU HAVE A PROBLEM INVOLVING

HIGH SPEEDS . . .
HIGH TEMPERATURES . . .
CHEMICAL CORROSION ?

INVESTIGATE
*PUREBON

*carbon-graphite especially designed for mechanical applications



Where lubrication is a problem on bearings, seals, blades and similar sliding or rotating parts, **PUREBON** is often the ideal solution.

PROPERTIES OF PUREBON

1. Stable at high temperatures
2. Light weight
3. Readily machinable
4. Low cost where moldable to size
5. Chemically inert
6. Moldable to size

REQUEST CATALOG #58
OR SEE SWEET'S
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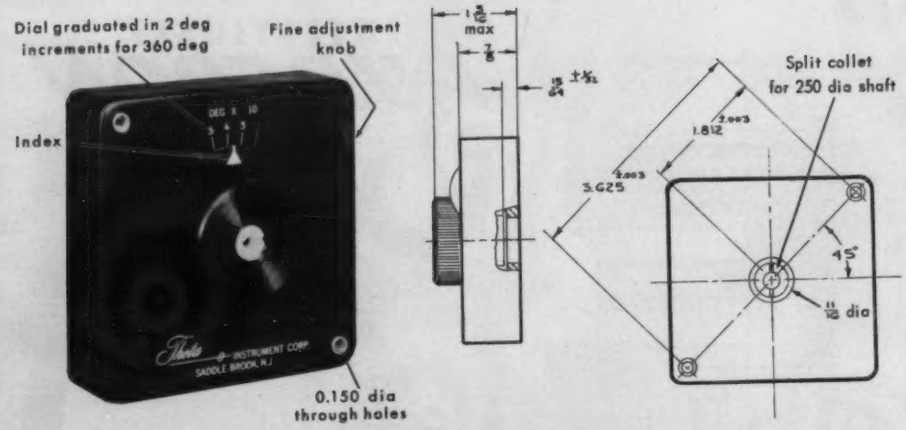
PURE CARBON CO., INC.
450 HALL AVENUE
ST. MARYS, PENNSYLVANIA

Circle 42 on Reader-Service Card for more information

NEW PRODUCTS

For more information on products described, circle on the Reader-Service Card the numbers appearing opposite the story headlines and drop the card in the mail.

MECHANICAL



Multi-Turn Dial 301

Geared to 36:1 Ratio

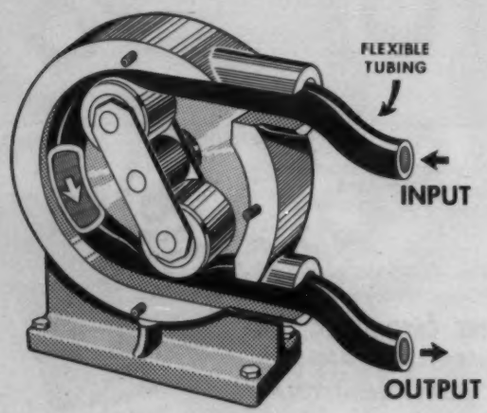
The "Mini-Dial" Model MDI-.250 is useful as a setting control for pots, condensers, coils and synchros. It may be inserted upon any shaft which projects from a panel. A coarse knob is connected 1:1 to output shaft for rapid turning. A built-in slip clutch prevents damage to devices of limited motion. A choice of scales is provided with graduations of either 0 to 360 or 0 to 100-deg divisions. Zeroing may be accomplished from front panel without loosening of parts. Face size is 3-1/16 inches square.

Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.

Laboratory 185-GPH Pump 302

Eliminates Fluid Contact of Moving Parts

Intake and outlet of this pump are one continuous flexible tube which passes through pump body where it is exposed to the "squee-gee" action of ball-bearing rollers. By selecting tubing material suitable to liquid being handled, a wide variety of corrosive, sterile and abrasive liquids or gases can be pumped without contamination or injury to pump. Since material being pumped always remains within tube, there is almost no limit to the number of liquids or gases that pump can move. The design of this unit makes it possible to put the pump into service without breaking existing tubing connections. This is an advantage in applications involving gases or liquids which must not be exposed to atmosphere. Less than a minute is required to insert a tube in pump. It is only necessary to remove pump's side plate and tube clamp in order to press tube into position around impeller rollers. Two models are available, with or without motor, speed controls or explosion-proof fittings. Models of 54 and 185 gph are obtainable.



Randolph Co., 1018 Rosine St., Houston 19, Tex.

Rotary A-C/D-C Solenoid 303

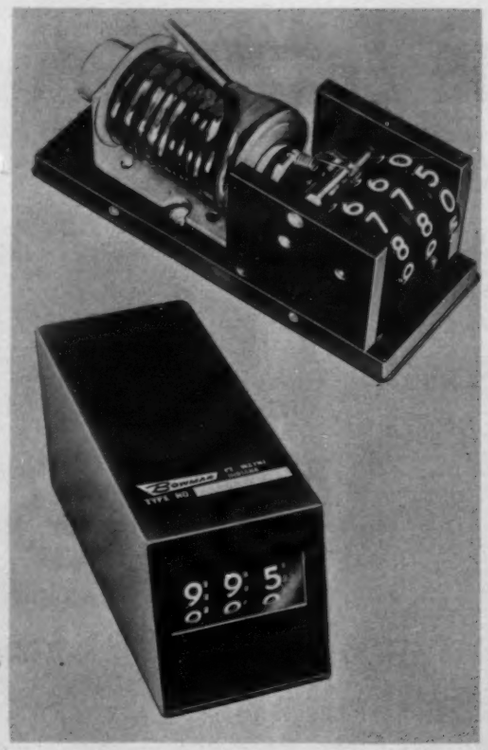
Measures 0.375 Inch Dia, 0.562 Inch Long

A micro-miniature rotary indicator weighs only 3.7 g and may be supplied for any standard voltage to 30v d-c or a-c at 400 cps. Also available for 100v operation with an external resistor, the unit is designed to use 100 mw or less when required. Rotation can be up to 60 deg, either clockwise or counterclockwise. Solenoid operates in a temperature range of —65 to 165F, is of rugged construction with jewel bearings and has a standard shaft of 1/32 inch diameter by 3/16 inch long.

Daco Instrument Co., Tillary & Prince Sts., Brooklyn 1, N. Y.

Impulse Counter 304

Responds to 1320 Impulses per Minute



A miniature impulse counter provides declining readings in 5-unit increments from a maximum reading of 995 to 000. Model 11576 is suited for installation in environments having severe space limitation. Weighing slightly more than 4 oz, overall size of epoxy-sealed housing is less than 1 inch square by 3 inches long. Counter window is 3/8 inch high and white characters on dull black wheels are 0.156 inch tall. Maximum speed of response is 1320 impulses per minute, providing a full scale or cycle of operation in 9 seconds when operated at that rate. Required input of unit illustrated is 10 to 12v d-c at 2w, but actuation from other conventional input voltages can be substituted. The device meets humidity, fungus, salt spray, sand and dust, acceleration, shock and vibration requirements of MIL-E-5272C (ASG), plus additional system specifications requiring reliable electrical operation at altitudes to 70,000 ft at temperatures from —20 to 71C. Counter is designed for 80-percent-on, 20-percent-off operation.

Bowmar Instrument Corp., 8000 Bluffton Rd., Ft. Wayne, Ind.

NAME YOUR STAINLESS SHAPE!

The design and manufacture of quality stainless steel castings is a specialized job . . . *and Dodge specializes in it!*

There is practically no limit to the variety of shapes we can turn out to meet your simple or intricate specifications precisely . . . economically.

Perhaps one or more DS castings shown here will help spark an idea of how Dodge can be of assistance for *your* stainless steel casting needs. A blueprint or sketch with operational details will bring complete information, without obligation.

DODGE STEEL COMPANY
6501 State Road
Philadelphia 35, Pa.
• *Phone: DEvonshire 2-2200*

DS DODGE PRODUCTS

THE MOST IMPORTANT ALLOY IN A STAINLESS STEEL CASTING IS QUALITY

Circle 43 on Reader-Service Card for more information

Split-Eyelet Connector 305

In installations requiring fittings for 1¼, 1½ and 2-inch piping or equivalent size tubing, No. 8370 eyelet connector frequently can offer considerable savings in overall cost. Since connector is easily and quickly installed to continuing or uncut pipe or tube lengths, installation time and fitting costs are significantly reduced. Connector is used in place of reducer tees and to connect such parts as spray nozzles, gages and hose nozzles. The split-clamp is made of cadmium-plated, heavy-gage steel or of stainless steel.

Bodies provide a ½-inch NPT female outlet and are made in a choice of brass and stainless steel. Connector is mounted by drilling an 11/16-inch dia hole in pipe or tubing and placing connector in position. Twin-bolt compression of clamp in combination with Buna-N gasket provides a leak-proof seal. Connector may be used for liquids and gases up to pressures of 150 psi.

Spraying Systems Co., 3241 Randolph St., Bellwood, Ill.

Take a lead from the leaders...

Since 1948, Amchem ALODINE* treated over 1½ Billion square feet

Popular Reynolds Colorweld pre-finished aluminum panels find wide application in commercial construction where its enduring performance and good looks are helping to change the architectural face of industry. Alodine contributes its protective qualities to Colorweld's amazing paint performance.

Conversion Coating Chemicals have of Aluminum in Reynolds Plants!

From 1955, when Reynolds Colorweld** Production was started, Reynolds has used ALODINE; Continue to Report Complete Customer Satisfaction with Paint Adhesion on this Quality Pre-Enameled Aluminum Product

At two Reynolds producing facilities—Atlanta, Ga. and McCook, Ill.—Alodine chemicals used in the pre-paint treatment of Colorweld offer a typical example of Reynolds' continuing emphasis on product quality.

Each day at these plants thousands of feet of aluminum are treated with Alodine to provide the metal with a chemical coating which produces high quality paint bonding characteristics so essential to the durable Colorweld finish Reynolds demands.

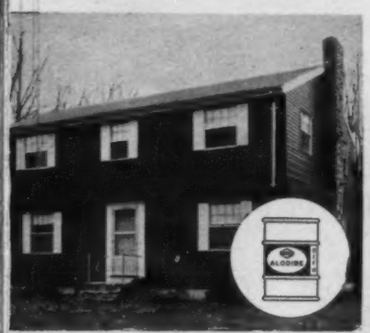
Alodine provided the first economical treatment that made possible the mechanical forming of pre-painted aluminum. Under extremely high volume processing speeds, the outstanding attributes of Alodine benefit aluminum products of all types—through improved paint bonding for subsequent mechanical forming operations, that means extra years of wear for painted aluminum under all types of environmental conditions.

Behind the success of Alodine as the outstanding pre-paint treatment for aluminum stand the research and development activities of Amchem's Metal Protection Laboratories where the search continues for even more efficient aluminum treating chemicals.

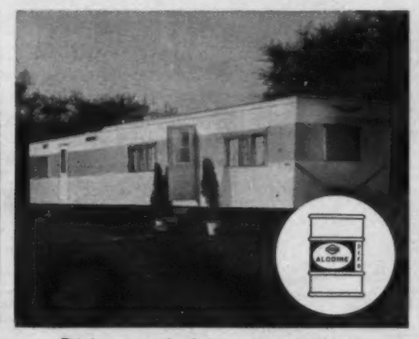
Take a lead from the leaders. If you're producing aluminum—bare or coated—specify Alodine for the assured quality and added beauty of your finished product.

*Amchem's registered trademark for its conversion coating chemical for aluminum.

**Colorweld is a registered trademark of the Reynolds Metals Company.



Beauty and durability characterize siding of Reynolds Aluminum Colorweld for home use. Alodine chemicals help provide a paint bond that lasts and lasts.



This home-on-wheels has more appeal, will last longer thanks to its body of Reynolds Aluminum Colorweld, and a firm paint bond thanks to Alodine.

At Amchem's Metal Protection Laboratories exhaustive quality control testing assures the performance of Alodine chemicals for every aluminum pre-paint requirement.

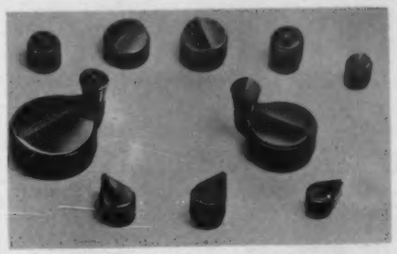
AMCHEM **ALODINE**

Write for Bulletin 1424C, gives detailed technical specifications on different Alodine chemicals available for pre-treating aluminum.

Amchem is a registered trademark of
AMCHEM PRODUCTS, INC. (Formerly American Chemical Paint Co.)
AMBLER, PA. • St. Joseph, Mo. • Detroit, Mich. • Niles, Calif. • Windsor, Ont

Circle 44 on Reader-Service Card for more information

Precision Control Knobs 306



More than 345 styles of precision-engineered control knobs are available for industrial and military use. Styled in black, gray, red and color caps, plus types for concentric control applications, knobs may be obtained with custom modifications to requested specification. As required in the new MS91528B, plastic molding material is acrylonitrile-styrene copolymer per L-M-525 and set screw sizes for ⅛-inch shafts, and knobs with diameters of 0.750 inch or less, have been changed from 5-40 to 4-40.

Raytheon Co., Industrial Components, 55 Chapel St., Newton 58, Mass.

O-Ring Seal Fittings 307

High-pressure fittings for leak-proof, 6000-psi WOG service range in sizes from ¼ to 2½ inches, in both tube and pipe sizes, for tailpieces and mating thread pieces. Use of O-rings as static seal provides positive sealing and eliminates leakage problems. Unions need only to be hand tightened for reliable performance at temperatures from —20 to 275F. Fittings are available in stainless steel or other material upon application. They are offered in female pipe, male pipe, socket weld (both OD tube and IPS) configurations and to MS 33514, AND 10050 and AND 10056 specifications, with union nuts to match.

Kahn & Co., Inc., P. O. Box 516, Hartford 1, Conn.

Bearing Takeup Frames 308

Multi-bearing takeup frames, available in 11 sizes, accommodate any type of bearing—babbitted, bronze, ball or roller—in any two-bolt pillow block with mounting holes up

to 5/8 inch. Frames allow horizontal bearing adjustments from 6 to 24 inches and will mount 143 different bearing shaft sizes from 5/8 to 2-7/16 inches in diameter. Mounting pads are adjusted to mounting holes in pillow block. Mounting bolts are zinc plated, and washers and nuts for mounting pillow block are furnished with each frame. All-steel frames have strong channels that form a rugged box frame with high rigidity. Channels also protect adjusting screw and provide easy access for lubrication and cleaning. Large diameter adjusting screw is zinc-plated for maximum protection against rust. Mounting feet, formed from heavy-gage steel, have two stiffening ribs for added strength, and pillow-block mounting pads are of one-piece steel-welded construction.

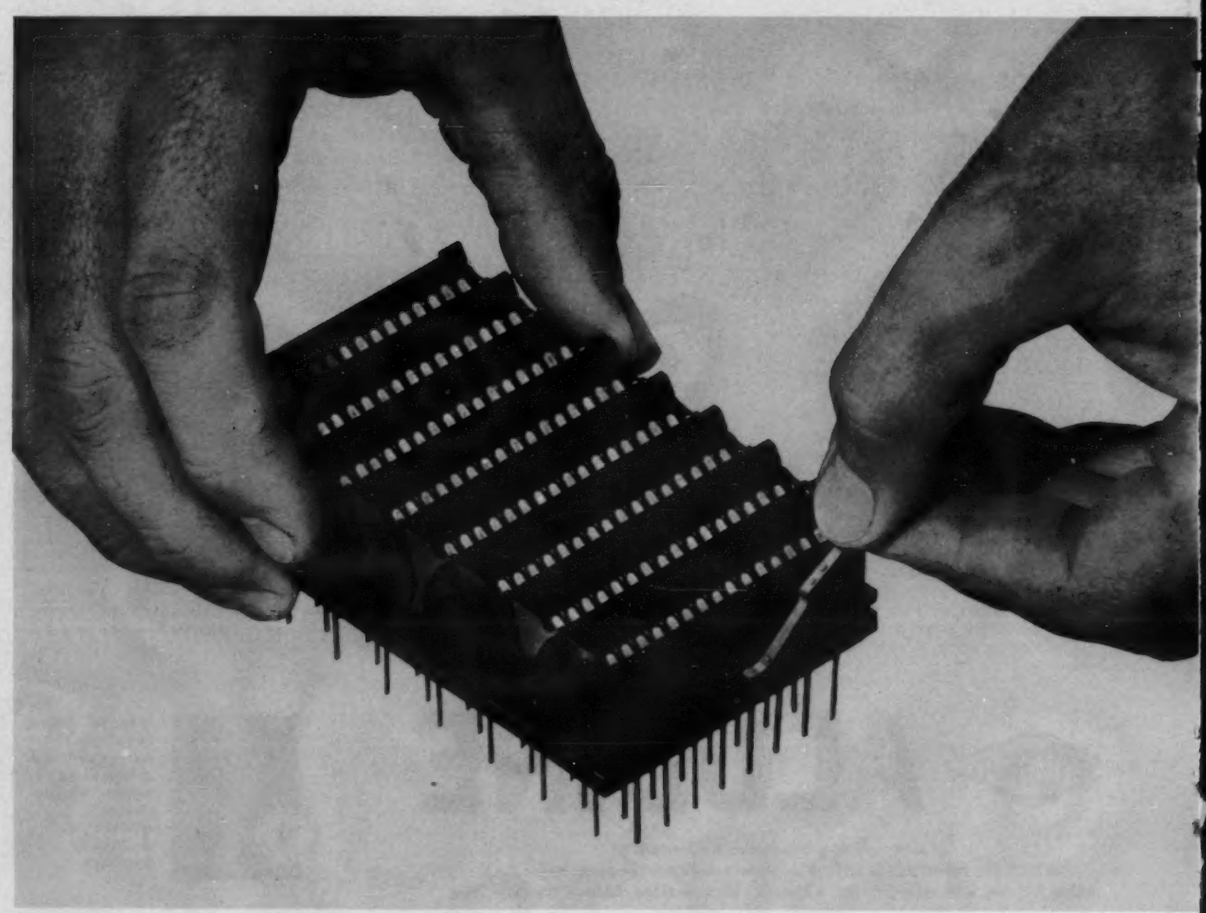
Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.

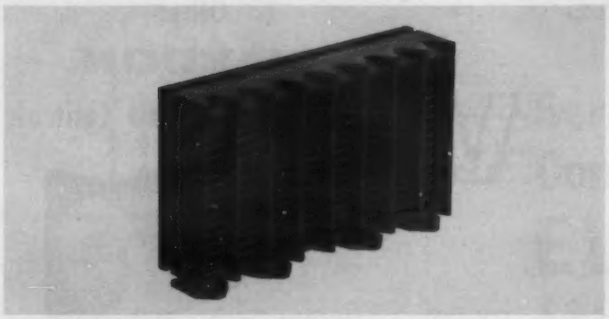
SYLVANIA PRODUCES & DELIVERS THE COMPLETED ASSEMBLY

—at substantial savings to IBM

This electrical connector block is a vital link in the electrical system of an IBM computer. Unless it is built to exact tolerances, the computer can malfunction.

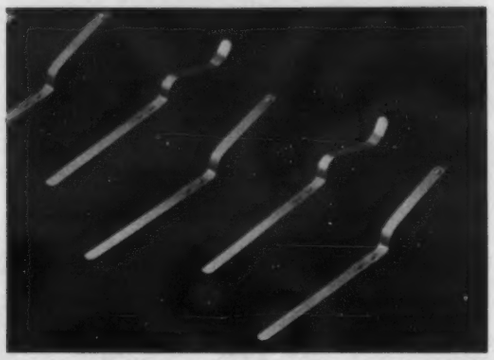
To make this critical part, IBM chose Sylvania because we could perform the entire production sequence—from raw materials to completed assemblies built to tolerances in terms of thousandths of an inch. It soon proved the Sylvania experience paid off in two ways: in production economies and in fast delivery too. Total result: a better connector block—at lower cost. (For details see captions to pictures on these pages.) For full information on how Sylvania custom facilities can benefit *you*, or for a quote on a specific project, write Sylvania Electric Products Inc., Parts Division, Warren, Penn.





MOLDED FROM PLASTIC by Sylvania, the IBM connector block meets tightest specifications. This is possible because Sylvania maintains one of the world's most modern and complete lines of automatic molding equipment. This equipment permits Sylvania to handle volume orders for compression, injection and transfer molding. And a unique bank of rotary presses can produce millions of precision parts each day—even using phenolics and urea.

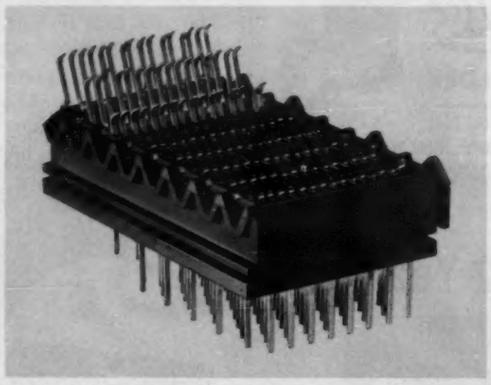
Result to IBM? Precisely formed parts to fill high-volume requirements.



MADE FROM SYLVANIA WIRE, precision-rolled ribbon connectors offer high reliability when the circuitry is completed using wire wrap contact methods. The cross section of the ribbon—.023″ x .062″—and the corner radius of .003″ were accomplished on a special three-head tandem rolling mill and special forming equipment.

Result of this flexibility to IBM? Top reliability at close tolerances.

CUSTOM METAL STAMPING AND DOT WELDING, in one operation, also paid big dividends to IBM. The original plans called for forming parts and then gold-plating the entire contact. Following a request by IBM to extend contact life and reduce costs, Sylvania experience paid off. Sylvania Engineers demonstrated they could weld a tiny gold dot at the contact point economically while maintaining close tolerance on the critical dimensions of the formed contact. High-speed, high-volume techniques enable Sylvania to meet critical deflection and sheer tests. Sylvania maintains a metal stamping facility which includes multi-slide machines, vertical presses, and specially developed machines to help solve your special problems.



CUSTOM ASSEMBLY by Sylvania of the block and the parade of contacts is handled by our corps of trained specialists. Many of our customers have found that Sylvania can often deliver completely assembled and packaged products—using either all Sylvania components or all customer components, or both—*at lower cost than is possible in the customer's own facilities.*

Result to IBM? Many, many thousands of completed top-quality assemblies per month, and to tolerances specified for automatic wire wrap.

QC SERVICE MEANS QUALITY CONTROL!

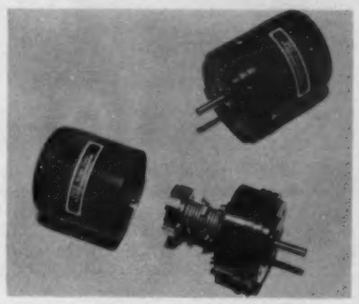
At Sylvania, a tough-minded, hard-to-please quality control department has full authority for assuring the parts Sylvania produces meet your most stringent specifications. Example of this thoroughness: for the IBM connector block, Sylvania used *100% inspection!*

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

Circle 45 on Reader-Service Card for more information

Adjustable Limit Stop 309



A precision limit stop assembly provides adjustable rotation limit control within an operational range of 30 to 4530 deg. The unit, in a 3/16-inch shaft size, is offered in ball or oilless bronze bearing types. Self contained in a black anodized case, 1¾ inches in diameter (size 18), the device is adjustable by setting a series of washers, each governing 300 deg of rotation. Unit may be factory preset to a specified stop.

PIC Design Corp., 477 Atlantic Ave., Rockaway, L. I., N. Y.

Piston Motors Pumps 310

Displacements of the C3F series motor and pump are 0.72, 1.09, 1.45 and 1.81 cubic inches per revolution. The units, rated for continuous duty of 3000 psi and intermittent pressures to 3500 psi, produce capacities from 3.3 to 8.5 gpm at 1200 rpm and 5 to 14 gpm at 1800 rpm. Operating speeds are up to 2400 rpm and largest unit can deliver 18 gpm at this speed. Used as motors, four sizes have theoretical torque ranges of 11.52, 17.28, 23.04 and 28.80 lb-in per 100 psi, or output hp (1200 rpm) ranging from 5.5 to 14 and (at 1800 rpm) from 8 to 22, operating at 3000 psi. Largest size operating at 2400 rpm can deliver 28 hp at 3000 psi. Mounting bosses of pumps are large enough to handle 1-inch NPT inlet or 1¼-inch OD tubing thread. Side ports may be mounted horizontally or vertically.

Webster Electric Co., Racine, Wis.

Robertshaw
Bellows Assemblies

Robertshaw Bellows Assemblies are Temperature Sensors which effect positive and accurate control of heat or cold in a myriad of domestic and industrial applications. At Robertshaw, they use ERSIN Multicore 5-Core solder because its non-corrosive ERSIN flux wets metals faster . . . and it holds reliably, even on metals which are difficult to solder.

ERSIN Multicore 5-Core solder costs Robertshaw a trifle more than ordinary solders . . . but this is negligible compared to the vital savings realized through more joints per pound—and virtually no costly rejects due to cold or H/R joints. For assembly line efficiency, guaranteed by 5-cores of ERSIN flux and fast melting thin-wall construction, quality manufacturers rely on ERSIN Multicore, the world's finest solder.

ERSIN Multicore
FIVE-CORE SOLDER

BIC ENDORSED QUALITY

*Multicore is approved under all applicable Federal Specifications

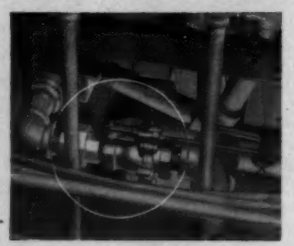
For information, write Department MB-1501

MULTICORE SALES DIVISION BRITISH INDUSTRIES CORP., Port Washington, N. Y.

Circle 46 on Reader-Service Card for more information

Trouble-Free thru 2 Years of Tough Service...

Rockwood Ball Valves



Used to test automatic laundry washing machines for water load, leakage and rinse cycle selections, these ½" Ball Valves are opened and closed approximately 50 times a day. After two years and 36,500 cycles, Rockwood Ball Valves are still leakproof and require no maintenance.

You, too, can depend on this same efficiency with Rockwood Ball Valves that are designed and engineered to give longer, trouble-free service.

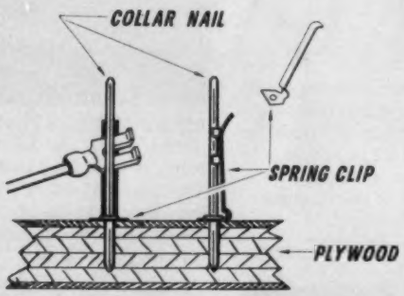
Rockwood Ball Valves are today giving outstanding service in oil refineries, food, paper, textile, chemical and rubber plants. Valves are available in pipe sizes from ½" to 10" . . . 300 lbs. working pressure. Tested and listed by Underwriter's Laboratories, Inc. For further information regarding your use of Rockwood Ball Valves write to ROCKWOOD SPRINKLER COMPANY, A Division of The Gamewell Company, *A Subsidiary of E. W. Bliss Co.* 848 Harlow St., Worcester 5, Mass.

ROCKWOOD BALL VALVES

Distributors in principal industrial areas

Circle 47 on Reader-Service Card for more information

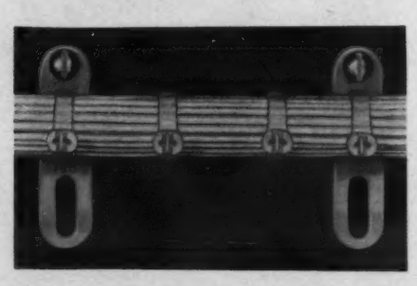
Harness Board Spring Clip 311



A conductor spring clip used with a collar nail aids in harness board assembly. The device holds lugs (spade or ring) or wire in place, permitting easy removal without damage. The SC-101 clip is made of hardened spring steel and is approximately 1⅛ inches high. Clip may be used with standard collar nails.

Stevens Cress Co., 39 Union Ave., Cresskill, N. J.

Wire Harness Clamp 312



A premountable clamp accommodates a complete range of harness sizes up to 4 inches. Once clamp is installed, it does not have to be dismounted should harness need reworking. Two mounting-bolt holes provide firm clamping. Used in conjunction with "Ty-Rap" cable ties and straps, this clamp and "Ty-Rap" replace 52 sizes of conventional clamps.

Thomas & Betts Co., 36 Butler St., Elizabeth, N. J.

Circle 48 on Reader-Service Card

Other HAYDON "Job Proven" Time Controls

ACROTIMER

DA-11

New "do-it-yourself" Acrotimer provides time delay or interval timing, opening or closing one or more switches after an adjustable period of time. Modular construction imparts versatility to meet a wide range of operation and design requirements. One basic unit plus easily assembled standard parts provides 12 design variations. Operates at 120 to 240 vac, 50 or 60 cps. Adjustable time ranges from 6 seconds to 24 hours available.

Series DA Time Delay Timer provides time delay or interval timing for applications such as protection of power tubes, or timing portions of a complete cycle of operations. Operates at 120 or 240 vac, 50 or 60 cycles. Switch capable of handling small fractional horsepower motors and components. Four models provide time ranges up to a maximum of 9.5 minutes.

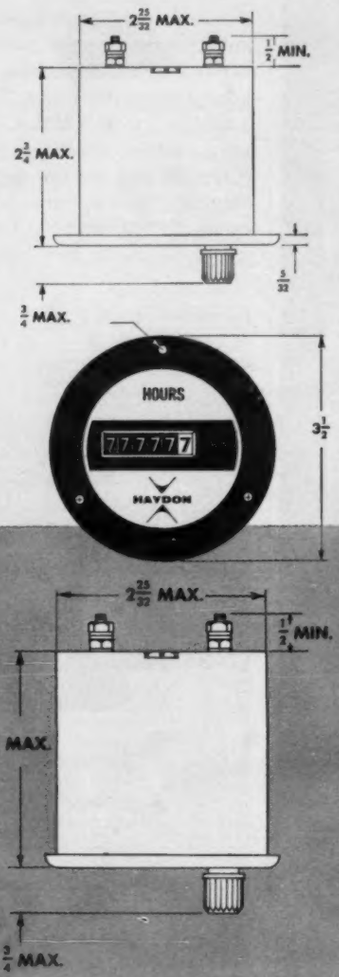
CATALOG: *Time and Torque Controls*

This 8-page catalog illustrates representative models of timing controls designed and produced by Haydon Division of General Time Corporation. Six types of electric timing motors and a dozen varieties of time and torque controls are shown with operating data and specifications. For more information on how Haydon can serve your time control requirements, write to the address below and ask for your free copy of Catalog No. G-1328.

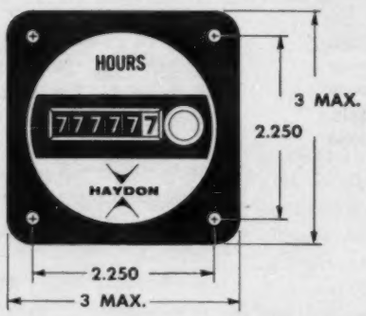
HAYDON
DIVISION OF GENERAL TIME CORPORATION
3226 East Elm Street
Torrington, Connecticut

TIME & TORQUE CONTROL

New Series EN and ER Commercial ELAPSED TIME INDICATOR



Ideal for use on machine tools and other industrial or commercial machines and equipment where an accurate record of operating time is required—for efficient preventive maintenance procedures, for rental-basis operation, or for substantiation of manufacturers' guarantees. High-styled face registers hours and tenths and minutes and tenths up to 99,999.9 in big, easy-to-see figures on a direct-reading dial . . . and offers you highest quality and reliability, compactness and light weight at a lower price than comparable units. Available in resettable and non-resettable models with 3½" round bezel or 3" x 3" square bezel. Designed for operation at 120 or 240 vac, 50 or 60 cps. Low input: 5.0 watts at 60 cps, 3.4 watts at 50 cps. Write today for complete information and engineering data: Haydon Division of General Time Corporation, 3226 East Elm Street, Torrington, Conn.

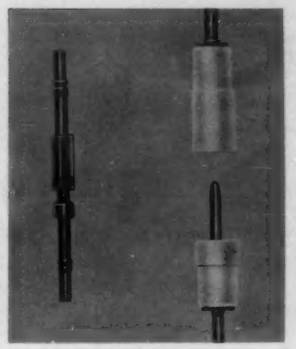


TIMING MOTORS
TIME AND TORQUE CONTROLS

HAYDON
DIVISION OF GENERAL TIME CORPORATION
3226 EAST ELM STREET
TORRINGTON, CONNECTICUT

'Teflon' Connectors 313

Single-pin, compression-mounted, male-female connectors have been subjected to environmental tests of temperatures to 200C, coupled with varying humidity and salt spray. Low losses have been found under these conditions, even when connector has been subjected to full limits of high power, high frequency and high voltage handling capabilities. The provision for "floating" the brass male and female connectors in their "Teflon" housings by means of E-ring retainers allows for tolerance build-ups on the part of the user to be as much as 0.005



inch off per connector, even when stacked in arrays. E-ring retainers also permit quick replacement of any part of male or female terminal without need of disturbing other connectors used in array. In use, terminal is compression mounted directly through metal chassis or terminal block. When engaged, connector has an overall length of 1.42 inches; when disengaged, male terminal has an overall length of 0.920 inch and female, 0.835 inch.

Jupiter Electronics, Inc., Sales Engr. Dept., 225 E. 144th St., New York 51, N. Y.

Circle 49 for Reader Service

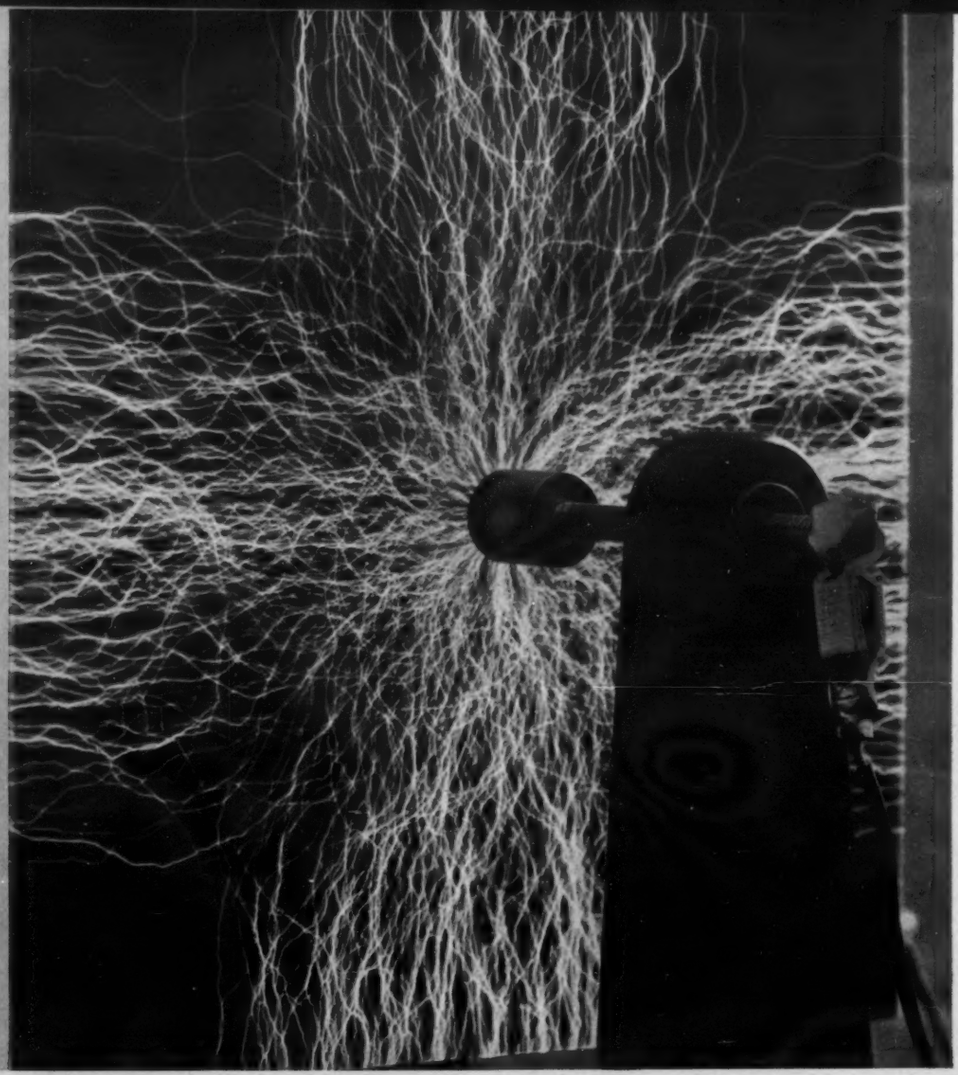
FORMICA®

puts the

plus+

in your

products



+with electrical grades that do more than just insulate

FORMICA ELECTRICAL GRADES	
Grade	Description
XXXP-36/paper-phenolic	High IR, cold punch to 1/16" for circuitry and non-circuitry applications.
XXXP-100FR/paper-phenolic	New flame retardant grade with high IR. Cold punch to 1/16". For commercial circuitry.
YN-25/nylon-phenolic	Low electrical loss for circuitry and non-circuitry applications requiring tougher material than XXXP-36.
FF-60/glass-melamine	Retains high dielectric strength after prolonged exposure to moisture. High impact.
FF-91/glass-epoxy	Low electrical loss for circuitry applications. High mechanical strength. Good machining.
FF-93-FR/glass-epoxy	New flame retardant grade with high IR and high mechanical strength. Good machining.
FF-95/glass-epoxy	Maintains good flexural strength at elevated temperatures; high IR.
G-7-1/glass-silicone	Heat resistant, low electrical loss, moisture resistant for non-circuitry electrical/electronic applications.
EP-37/paper-epoxy	Flame retardant/self-extinguishing with superior dimensional stability for circuitry applications.

Check the chart. Note how Formica electrical grades combine insulation with mechanical and/or chemical properties. The extra property values of these and other Formica industrial plastics can put plus performance and added sales power into your products. For detailed information, write for data sheets today.

Your Fabricator and Distributor of Industrial Formica can put the plus in your products *but quickly*—with fast, local delivery of Formica fabricated parts and materials. Check the list on opposite page . . . phone your fabricator now.

FORMICA®
Industrial Plastics

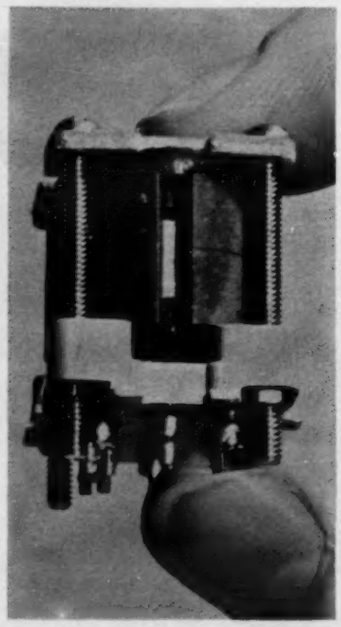
FORMICA CORPORATION, 4511 Spring Grove Ave., Cincinnati 32, Ohio

subsidiary of CYANAMID

ELECTRICAL

High Q Coils 314

Pot core constructed high Q coils and transformers are available as variable or fixed units for the 50-kc to 1-megacycle range. This line complies with MIL-C-15305A; units operate effectively to 125C (Class B) and are for use in hermetically sealed units. The Q range is 100 to 300. Units are 25/32 by 25/32 inch and 15/16



inch in height. Weight is 0.7 oz. Stability is 150 parts-per-million per deg C. Pot core design provides magnetic shielding, and electrostatic shields are available with inductances up to 150 mh. Shock and vibration limits exceed 30 G at 50 to 2000 cps.

Bulova Watch Co., Inc., Electronics Div., 40-01 61st St., Woodside 77, N. Y.

Circle 50 on Reader-Service Card

Faster Delivery of
FORMICA®
Sheets and Fabricated Parts from your

FABRICATOR AND DISTRIBUTOR OF

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Industrial Plastics

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Los Angeles — Conroy & Knowlton, Inc.; Leed Insulator Corp.; Tri-State Supply Co.; Plastic Stamping, Inc. (Pomona)
San Francisco — Laminated Fabricators; Tri-State Supply Corp.
San Diego — Ridout & Co.
COLORADO:
Denver — Plasticrafts, Inc.
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Arlington — Milton H. Brooks & Son
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Atlanta — Southeastern Plastic Sales Co.
ILLINOIS:
Chicago — Colonial Kolonite Co.; Tingstol Co.
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Indianapolis — Hyaline Plastics Corp.
Michigan City — Television Associates, Inc.
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Louisville — C. Lee Cook Co.
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Boston — Insulating Fabricators of N.E.
MICHIGAN:
Dearborn — F. B. Wright Co.
Detroit — Chas. R. Mueller & Sons
Grand Rapids — Novel Products
Jackson — Plastigage Corp.
MINNESOTA:
Minneapolis — Special Parts, Inc.
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NEW YORK:
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New York City — Commercial Plastics & Supply Co.
Richmond Hill, Queens — Comco Plastics
Poughkeepsie — Industrial Plastic Supply
Rochester — General Circuits, Inc.
Syosset, L. I. — Frank Products
West Nyack — Plasticraft Products Corp.
NORTH CAROLINA:
Gibsonville — Engineered Plastics, Inc.
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Dayton — Dayton Plastics, Inc.
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Tulsa — Ideal Specialty Co.
PENNSYLVANIA:
Harrisburg — D. & H. Dist. Co.
Philadelphia — Laminated Materials; Mascher & Lippincott
Pittsburgh — Earl B. Beach Co.
TENNESSEE:
Memphis — Norrell, Inc.
Nashville — Plastic Fabricators Co.
TEXAS:
Fort Worth — Plastelite Engineering Co.; Service Engineers, Inc.; Standard Parts & Equipment Corp.
Houston — Houston Gasket & Packing; Replacement Parts Co.
UTAH:
So. Salt Lake City — Plastic Products of Utah
VIRGINIA:
Bristol — Williams Co.
Norfolk — Norva Plastics
Richmond — Plywood Center
WASHINGTON:
Seattle — Tri-State Supply Co.
WISCONSIN:
Milwaukee — General Plastics, Inc.
West Allis — Colonial Kolonite Co.

Transistor Retaining Clips 315

Retaining spring clips for socket-mounted TO-5 and TO-9 series transistors comply with military requirements for retention of plug-in devices. Clips, designated 3B-714-1 and 3B-714-2, provide a positive spring pressure retention on transistor case top and easy access for service. Mounting is accomplished by means of screw or rivet which attaches transistor socket to chassis. A locking tab on clip positions it and prevents twisting. Two heights are obtainable: for transistors with mounting height dimensions of 13/64 and 21/64 inch. Material is beryllium copper per QQ-C-533 with a silver plate finish. Clips can be used in applications where heat removal is required, in combination with transistor radiator devices such as the 3AL-635 series.

Birtcher Corp., Industrial Div., 745 S. Monterey Pass Rd., Monterey Park, Calif.

Safety Switch 316

The "TO" safety switch utilizes the principle of a suspended weight maintaining its vertical position at all times. When properly mounted in an appliance, the contacts are held closed until appliance is tilted 30 deg or more. At this point, vertical weight remains in position and exerts a lifting motion on operating contact spring which opens circuit.

Norwalk Thermostat Co., 65 Norwalk, Ohio.

SEALING DOMESTIC APPLIANCES IS A REAL CHALLENGE, TOO!
Limited axial room and large diameter are mechanical requirements in this washing machine seal. Design features multiple spring construction for even face loading.
FIVE ADAPTATIONS OF THE John Crane® TYPE 6A SEAL for four different appliance manufacturers
Standard 6A Seal with specially designed seat conforming to impeller contour so as to promote good water flow characteristics.
Seal features outer periphery face construction to best service garbage disposal conditions.
Two sealing points in a washing machine with widely differing physical limitations, yet seals for both retain full advantage of diaphragm action, shouldering points and positive drive.

Soapy water, detergents, bones, grit and lint . . . all these combine to make appliances a hard-to-handle sealing problem. Add that to a very limited space factor, and you've got a real set of conditions on your hands.

"John Crane" engineers have solved these problems and thousands of other shaft sealing applications on all types of commercial and industrial equipment. We know that we can be of the same help to you.

That's why . . . as one design engineer to another . . . we urge you to let us work with you in adapting or developing the proper seal for your application.

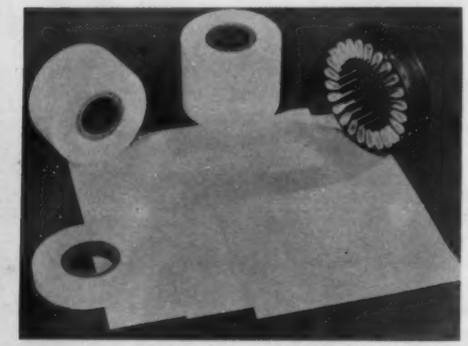
Tell us about your requirements or write for our fully illustrated Bulletin S-204-3 on "John Crane" Shaft Seals.

Crane Packing Company, 6423 Oakton Street, Morton Grove, Illinois, (Chicago Suburb). *In Canada:*
Crane Packing Co., Ltd., Hamilton, Ont.

CRANE PACKING COMPANY

Circle 52 on Reader-Service Card for more information

Polyester Laminate 317



Designated No. 2541, this triplex constructed material will not delaminate in contact with solvents used in varnish impregnation. The absence of glues, adhesives and impregnants provides improved resin or varnish-to-film adhesion, eliminating voids or gaps which encourage moisture attack within impregnated or encapsulated units. Varnishes or epoxy resins are absorbed by the non-woven polyester web outside layers, establishing a tight bond to inner layer of film. The non-woven web construction gives insulation the same tensile strength in all directions, eliminating need for caution in cutting or inserting material along "grain". For typical applications such as slot, phase and layer insulation, the material has the right amount of rigidity and "spring-back" for slot wall conformance, making insertion of coil windings easy. Bending or other movement stresses during assembly do not affect material's dielectric strength. Laminate is offered in three standard thicknesses: 0.007, 0.010 and 0.015 inches.

Minnesota Mining & Mfg. Co., Irvington Div., 900 Bush Ave., St. Paul 6, Minn.

Heat-Resistant Paint 318

"Heat-Rem H-170 Super" withstands temperatures to 1700F. Available in both aluminum and clear vehicles, the material is especially recommended for fine tolerance work. It is claimed to be widely used on torch weld jigs on which rocket engine chambers are formed. In addition to spray application, paint may be used for dipping or brushing.

Speco, Inc., 7308 Associate Ave., Cleveland 9, Ohio.

Designers think of R/M first for asbestos, rubber,

Poly-V "J" Light Duty Drive Gives You Design Advantages Never Before Possible

Most Revolutionary Drive for Small Sheaves, Short Centers, Compact Units

R/M POLY-V® "J" DRIVE is industry's newest and most revolutionary light-duty drive for small diameter sheaves, short centers and compact units. It utilizes a single parallel V-ribbed belt running on space-saving sheaves grooved to mate precisely with the belt ribs. Design advantages of Poly-V "J" add up to more dependable power in less drive space wherever balance and highly efficient, silent, vibration-free drive performance are required.

Advantages

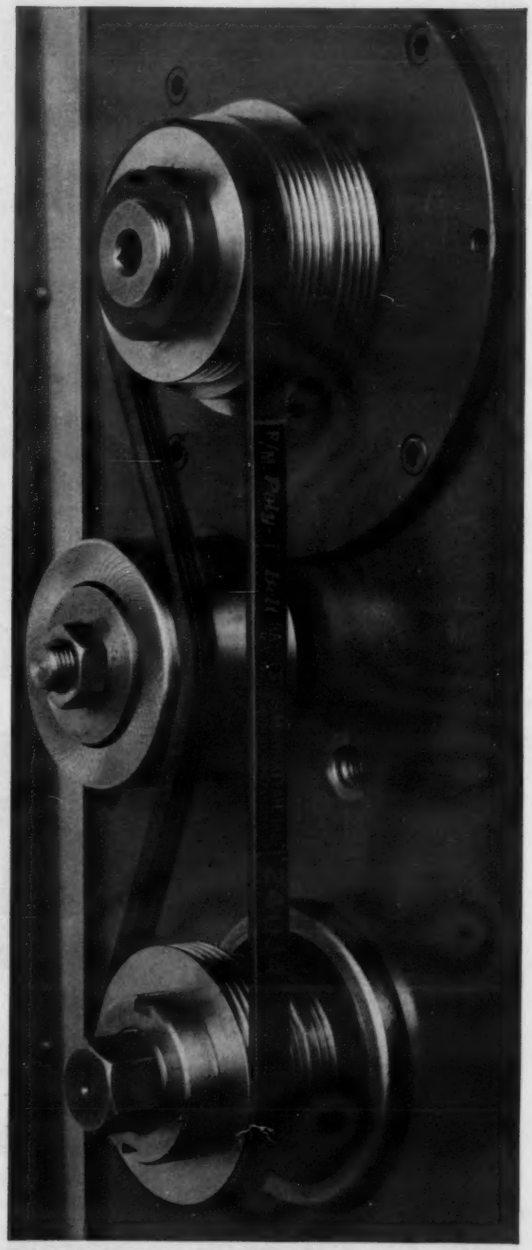
- **Designed especially for small sheaves; considerably below V-belt range**
- **Silent, vibrationless, cool operation; homogeneous traction surface is spliceless, lapless**
- **No belt matching; a single belt cross section meets every need from 1/40 to 15 HP**
- **Delivers much more load in less space; permits more compact drive with smaller mounting clearances**
- **Exceptional flexibility; operates easily with midget motors**
- **Ideal for tandem, mule, ¼ turn or serpentine drives; with reverse bend idlers and for speeds up to 10,000 f.p.m.**
- **Minimum drive wear; assures longer belt and sheave life**
- **Absorbs shock; overload slip protection against machine damage**
- **Complete contact pressure; maintains groove shape**
- **Heat and Oil Resistant**

Poly-V "J" has been proved for smooth, silent power service on a wide range of small machinery—home workshop, machine tools, wash machines, lawn mowers, household appliances, and for many types of industrial, commercial and scientific machines.

For medium and heavy duty drives, R/M Poly-V* is available in the larger "L" and "M" Sections. These 3 Poly-V Belts (J, L and M) will replace 8 V-belt size sections and cover a power range from 1/40 to 1700 HP. Wherever your design problems involve power transmission drives, V-belts, flat belts . . . rely on R/M products and engineering.

RUBBER

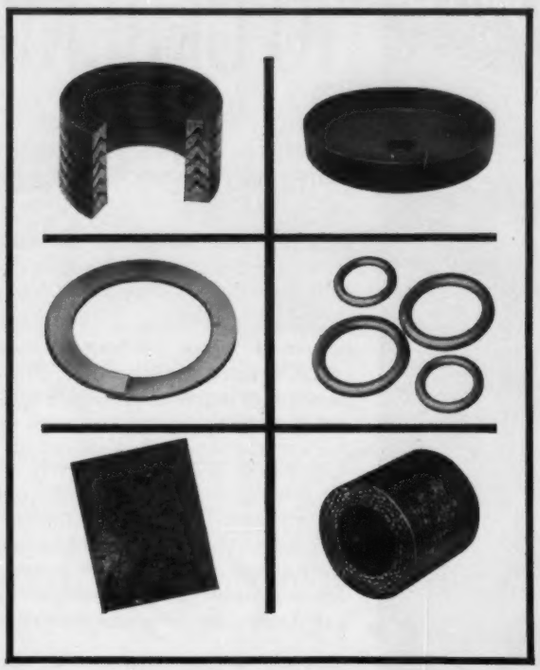
Write today for free booklet shown: full details on a wide variety of industrial rubber products. Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N.J.



Poly-V "J" on Parker Majestic Grinder as standard equipment

Circle 53 for more information on Rubber

sintered metal, and engineered plastic products



TEFLON* HEADQUARTERS U.S.A.

SHEETS • RODS • TUBES • TAPES
HOSE • BONDABLE TEFLON
MACHINED PARTS • SPECIALTIES

One call does it all. Ask the man from R/M for *anything* you need in "Teflon"—standard shapes to finished parts. He can satisfy your requirements fast and efficiently.

By any measurement—research, complete line, experience, technical data, capacity, quality control, delivery and reputation—R/M should be your *first source* for "Teflon" products.

R/M "Teflon" Headquarters has grown to its present stature through the outstanding dependability of its *own* production and delivery as well as the performance of its finished products.

Contact your nearest R/M district office . . . or write for the application service that cuts costs without cutting corners.

**Registered trademark for Du Pont fluorocarbon resins*

PLASTICS

For a copy of this booklet, full of information on R/M's complete line of "Teflon" products, write Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

R/M CAPABILITY PRODUCES REINFORCED TEFLON PACKINGS

to lower friction, eliminate contaminating lubricants, resist corrosion and extrusion

Now you can get "Teflon" packings with the exact mechanical properties you require. R/M capability has developed a host of reinforced Teflon packings, one or more of which may meet your requirements.

Among these are Vee-Flex® rings, piston cups, gasket materials, and specially machined and molded products. Each is designed for a specific application—using the advantages of Teflon coupled with the advantages of other materials.

R/M's broad experience in design, compounding and manufacturing of mechanical packings and gasket materials is at your disposal. Send data on your specific application.

PACKINGS

Write for new catalog giving complete information about Reinforced Teflon Products and other R/M packing and gasket materials.

RM 110

RAYBESTOS-MANHATTAN, INC.

FACTORIES: Passaic, N.J. • Bridgeport, Conn. • Manheim, Pa. • Fullerton, Calif. • No. Charleston, S.C.
Crawfordsville, Ind. • Neenah, Wis. • Peterborough, Ontario, Canada

Circle 54 for more information on Plastics

Circle 55 for more information on Packings

Subminiature Alumina Ceramics 319

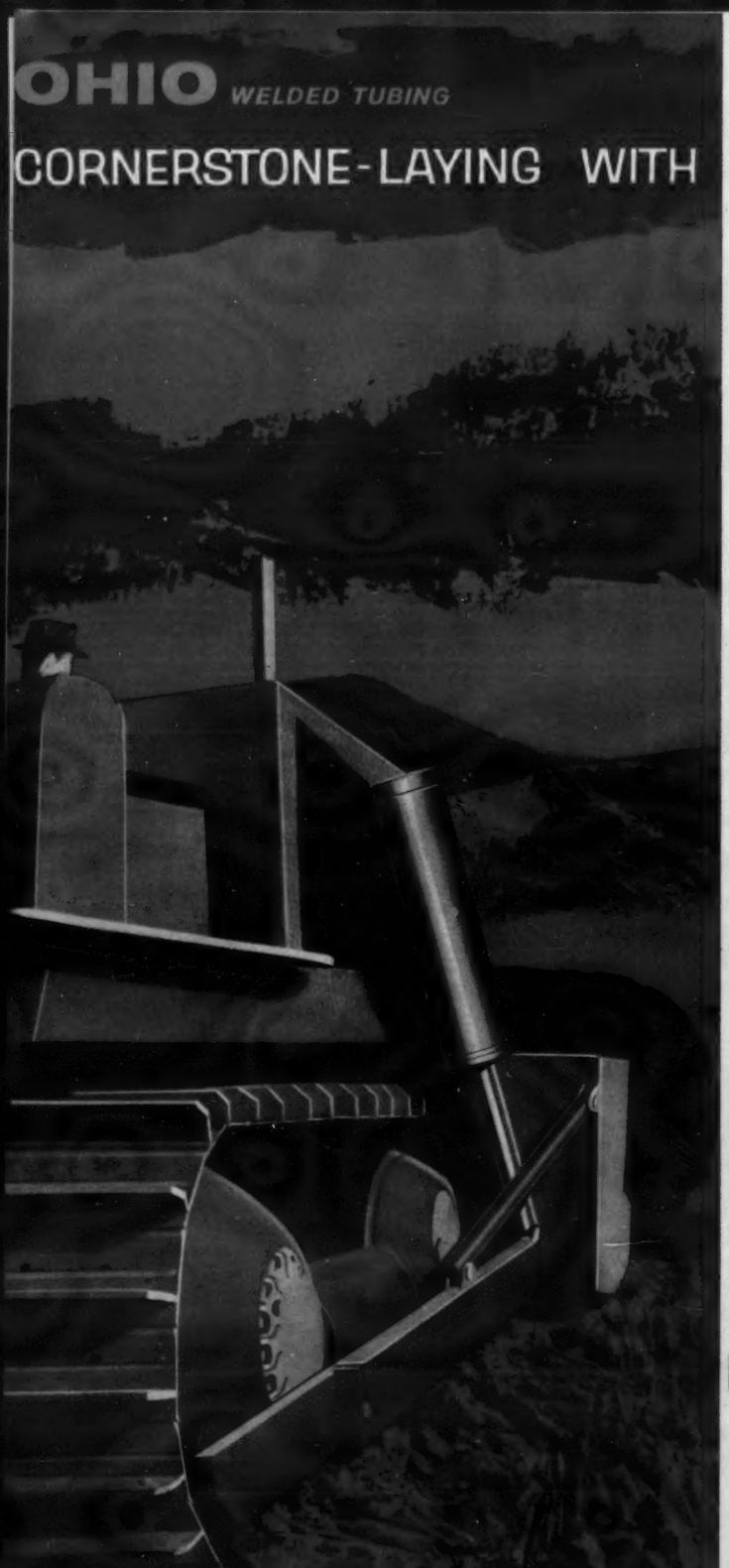
Parts and components of "Diamonite", which contain up to 97 percent alumina oxide, possess high dielectric strength at high frequencies and elevated temperatures. They are non-magnetic, non-conductors of electricity, vacuum tight and readily metallized. The smaller parts illustrated measure 0.050 OD by 0.030 ID by 0.045 inch long. They are being fabricated for use in the manufacture of semi-conductor assemblies. The larger miniatures shown are 0.162 OD by 0.097 ID by 0.050 inch long. The material is characterized by good physical properties with high compression strength and good resistance to mechanical shock.

Diamonite Products Mfg. Co., Shreve, Ohio.

Transfer Solution 320

"Trace" is a process for transferring drawings to an illustration material before rendering. The diazo-type sensitizing solution is applied to an illustration material surface in a spray from a 12-oz pressurized container, and will transfer any well-prepared translucent sketch, pencil or ink drawing, film positive or transparentized opaque matter such as photographs and stats. The method of transfer has many advantages: no darkrooms are needed for processing or handling; immediate copy; will not smear; hours of tracing time eliminated; can be used on either light or heavy-weight illustration material; low-cost and simple application; and stocks of short-lived expensive copying papers are eliminated. This is an invaluable aid for designers, architects, artists, engineers and draftsmen.

West Reproduction, P. O. Box 2336, Ft. Dearborn Station, Dearborn, Mich.



OHIO WELDED TUBING

CORNERSTONE-LAYING WITH

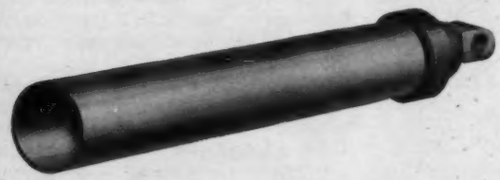
NO CEREMONY

In today's hustling, bustling construction business there's no time to stand on ceremony . . . no point in risking costly equipment failure.

To short-circuit mechanical downtime, leading construction equipment producers specify Ohio Tubing for power cylinders and fluid lines, mechanical and structural members. This gives equipment the heft and brawn to shrug off brutal, grinding punishment . . . gives equipment users a high degree of protection against disastrous delays.

You can strengthen your product — and its mechanical reputation — by specifying Ohio *Custom Made* Tubing. The name Ohio is the hallmark of the highest quality in tubing, both seamless and welded. And we're now able to deliver a broader range of welded tubing sizes, wall thicknesses and grades than ever before.

Let's not stand on ceremony. We want your tubing business — seamless to 7" OD, *welded up to 7½" OD.* For a fast start, contact your nearest Ohio representative, or send part drawings to the plant at *Shelby, Ohio—Birthplace of the Seamless Steel Tube Industry In America.*



Ohio Seamless offers the broadest parallel range of both welded and seamless quality steel tubing in the industry.

OHIO SEAMLESS TUBE

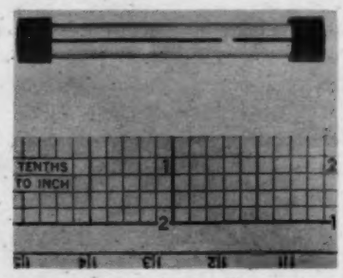
Division of Copperweld Steel Company • SHELBY, OHIO

Seamless and Electric Resistance Welded Steel Tubing • Fabricating and Forging

Representatives in principal cities. Check leading directories: THOMAS', MacRAE'S, CONOVER-MAST, SWEET'S, FRASER'S.

Ampere-Hour Meter 321

A reversible, direct-reading, miniature ampere-hour meter with negligible operating current gives improved accuracy and high readability. Two inches long and ¼ inch in diameter, the device is a lightweight microcoulometer, integrating current versus time by electro-chemical principles, using a mercury anode separated from a



mercury cathode by a small liquid electrolyte gap. Under an applied voltage, current flow transfers mercury quantitatively across gap via balanced oxidation-reduction reactions. Model 100 has a 1½-inch active scale length and is suited to applications where space and weight are of primary importance. The device operates on any d-c input voltage and uses a series resistor to adjust operating current through meter to desired integrating rate. For normal applications, the indicator requires less than 100 microamperes of current and imposes no appreciable drain on power supply. The unit can be supplied with either prefabricated fuse-type clips or extended input leads for convenient solder mounting in any circuit configuration and in any position.

Curtis Instruments, Inc., 45 Kisco Ave., Mt. Kisco, N. Y.

Circle 56 on Reader-Service Card

PROTECT YOUR PRODUCTS WITH LOW COST

LISLE *Magnetic* **PLUGS**

If your product has moving parts operating in a fluid, you can reduce costly wear with Lisle Magnetic Plugs.

Ferrous metal particles in a lubricant are a major cause of wear. The Lisle Magnetic Plug removes these particles from the lubricant — assures longer, quieter operation of the products you make.

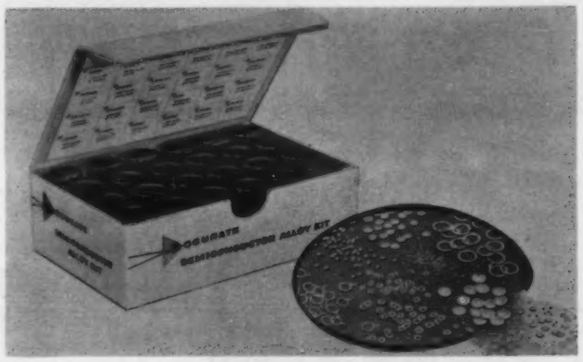
Lisle Magnetic Plugs can be used in place of any ordinary drain or fill plug.

FREE Samples for Testing in Your Product!

LISLE CORPORATION Clarinda, Iowa

Circle 57 on Reader-Service Card

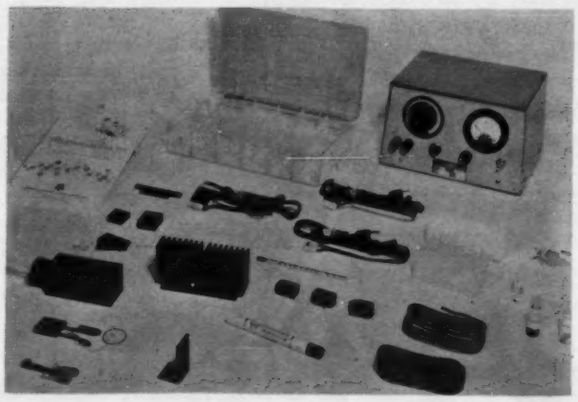
Semiconductor Alloy Kit 322



Containing over 25,000 semiconductor preforms, kit Z-100 contains a complete range of material in usable forms such as discs, washers and spheres. New clad metals finding greater application in industry, such as indium-clad aluminum, are included. Kit contains 24 different alloys for use in both germanium and silicon diodes, rectifiers and transistors. Other alloys include tin-antimony, lead-silver, indium-germanium, tin-lead-antimony, 99.999-percent pure indium, and aluminum-boron, among others.

Accurate Specialties Co., Inc., 345 Lodi St., Hackensack, N. J.

Thermoelectric Experimental Kit 323



The type 300 experimental kit enables electronic, industrial, medical and educational organizations to obtain empirical knowledge directly of thermoelectric materials, principles and techniques in a planned and organized manner. Contained in the kit are typical Frigistor cooling modules made of "Neelium" (one of the more advanced thermoelectric materials now in production) as well as all necessary hardware to conduct a broad spectrum of basic experiments in thermoelectric cooling and power generation. Also included is a complete 38-page instruction book and laboratory manual which describes 10 principal experiments and provides other information on thermoelectricity of interest to the user.

General Thermoelectric Corp., Princeton, N. J.

this FREE ENGINEERING MANUAL

tells why tOtal 2 solves all **retaining ring PROBLEMS!**

E-RING DESIGN • SPECIAL RING SHAPES • STACKED RINGS

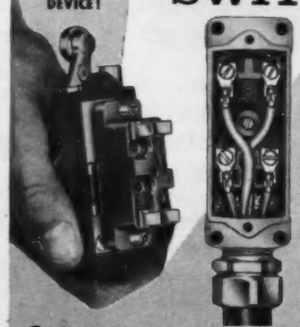
With Ramco's Circolox and Spirolox you have the tOtal 2 designs needed to solve all retaining ring problems. This Free Engineering Manual brings you the complete tOtal 2 story—write for it today!

RAMSEY CORPORATION *a subsidiary of* ***Thompson Ramo Wooldridge Inc.***
Box 513, Dept. A, St. Louis 66, Missouri 169

Circle 58 on Reader-Service Card for more information

NEW! EASY·TO·USE *PLUG-IN* LIMIT SWITCH

6 MOUNTING ARRANGEMENTS WITH 1 DEVICE!



- Oil-tight construction
- Switch plugs in—in seconds
- Mounts without disassembly
- Wired without removing from box
- Reversible plug-in unit—can be plugged-in with roller arm at either end
- Present installations easily converted to plug-in
- Same price as standard Square D oil-tight limit switch

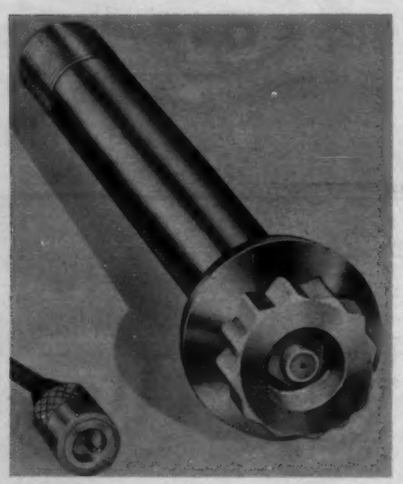
Write for Bulletin 9007AW to Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin

SQUARE D COMPANY
wherever electricity is distributed and controlled

Circle 59 on Reader-Service Card for more information

Strain Gage Fastener 324

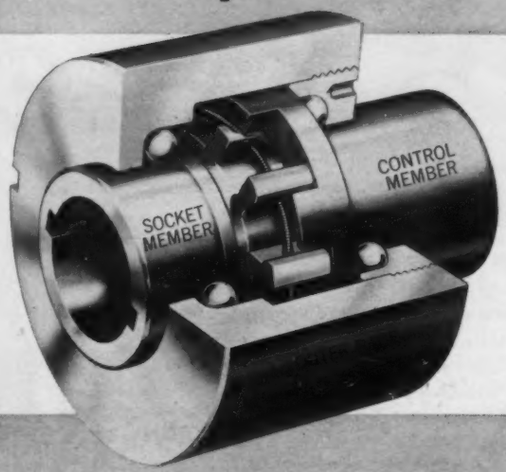
An electric strain gage, bonded and sealed in a small hole along the longitudinal neutral axis of a bolt, allows direct measurement of fastener tension load. Available in all external wrenching standard cap screw, hex head and 12-point superstrength bolt sizes, the fastener indicates bolt tension load with a guaranteed accuracy of better than 1 percent, providing correspondingly high reliability and structural efficiency to bolts and bolted joints. Tightening loads or changes in bolt load due to vibration, shock or wear may be observed or recorded remotely.



Special fasteners are gaged to specifications for testing, control, safety, load force and acceleration measuring purposes. Standard strain gage instruments are used. Electrical specifications of gage are: resistance, 240 ohms, ±0.4 ohms; gage factor, 2.00 ±0.01; input current (maximum), 30 ma a-c or d-c; input voltage (maximum), 7v a-c or d-c; linearity, better than 1 percent; accuracy, within 1 percent of allowable bolt load; and output sensitivity, 0.5 microvolt/volt/micro-inch strain.

Strainsert Co., E. 4th St., Bridgeport, Pa.

NOW! a positive positioning device that stops feedback torque without backlash....



Rev-Lok devices can efficiently perform a number of application functions such as two-directional drive, positioning, over-running, backstopping, prevention of feedback, etc. Generally, the mounting arrangement used determines which functions are obtained. However, to provide specific details on how Rev-Lok components operate to perform individual functions, sketches and description relating to several typical applications are provided on the facing page.

Now! For any application requiring a power transmission device, that will drive in both directions and instantly stop all feedback torque, the REV-LOK design offers precision performance characteristics and safety factors previously unobtainable in so compact a product.

REV-LOK features a complement of sprags arranged in opposing pairs to automatically and instantly stop feedback in both directions of rotation . . . there is no backlash on output shaft. Also, the design concept provides multi-contact surfaces for greater driving and holding torque, assures equalized radial loading of REV-LOK devices, and evenly distributes wear over all sprags and entire race surface to secure longer life.

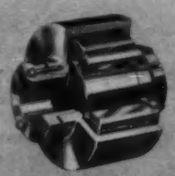
The functional versatility of the REV-LOK device is evidenced in its successful use on many diverse applications. Depending on the mounting arrangement employed, REV-LOK devices can be used for: two-directional drive and positive positioning, two-way over-running or backstopping, dual drive or single revolution applications, anti-shock steering, torque limiting, etc.

REV-LOK devices have greater torque capacity for their size and weight, and permit higher over-running speeds than any similar product. Current catalog models are available in torque ratings from 90 lbs. in. to 30,000 lbs. in. and with bore diameters ranging from ¼" to 2½". Send for your free REV-LOK catalog—it provides further operational and technical details.

FORMSPRAG COMPANY

23605 Hoover Road, Dept. 115, Warren (Detroit), Michigan

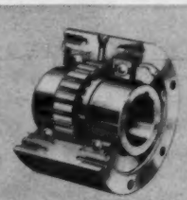
Representation Throughout The World • Precision Power Transmission Products



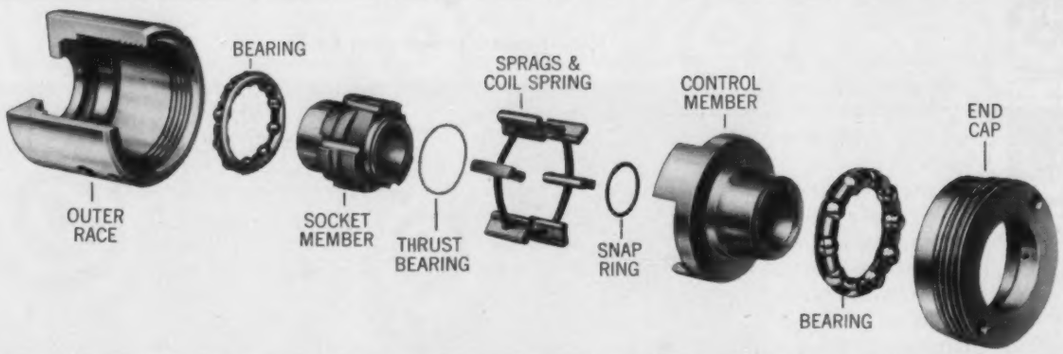
OTHER FORMSPRAG® PRODUCTS

Rawson® Centrifugal Clutches for no-load motor starts and cushioned starting of loads.

Formsprag® Clutches for every over-running, indexing and backstopping application.



....this is REVLOK



HERE'S HOW REVLOK DEVICES FUNCTION

With the OUTER RACE held in a stationary or fixed position, torque is transmitted as follows: (Figure 1) The CONTROL MEMBER projects between each pair of opposing sprags and when driving torque is applied to it, each projection first contacts a sprag at point "A" to disengage the sprag from the OUTER RACE. Then, the CONTROL MEMBER drives against the sprag at point "B" to transmit driving torque directly to the SOCKET MEMBER. (Figure 2) When input torque is reversed, the CONTROL MEMBER rotates a maximum of 3° to release the opposing set of sprags and then again drives the SOCKET MEMBER through point "B" on these sprags. (Figure 3) Any input torque from the SOCKET MEMBER is instantly stopped by the wedging of sprags between the fixed OUTER RACE and the SOCKET MEMBER—feedback torque never reaches the CONTROL MEMBER.

(Figure 4) When the SOCKET MEMBER is held stationary and the CONTROL MEMBER is held in a neutral position between the sprags, any input torque applied to the OUTER RACE is instantly stopped by the wedging of the sprags between OUTER RACE and fixed SOCKET MEMBER. However, by applying a relative torque to the CONTROL MEMBER in one direction (Figure 5), the OUTER RACE can over-run in the opposite direction and will also be backstopped. To reverse the direction of OUTER RACE over-running and backstopping, the torque applied to the CONTROL MEMBER is reversed.

(Figure 6) If the CONTROL MEMBER is held in a fixed position and the SOCKET MEMBER is allowed to float freely on a shaft, the OUTER RACE will over-run in either direction. However, if a torque is applied to the SOCKET MEMBER, the OUTER RACE will only over-run in the direction that the torque is applied and will backstop in the opposite direction.

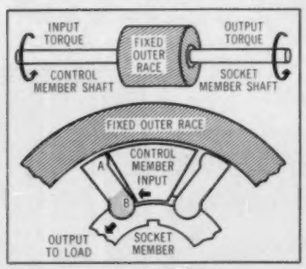


FIGURE 1

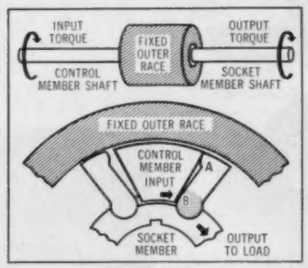


FIGURE 2

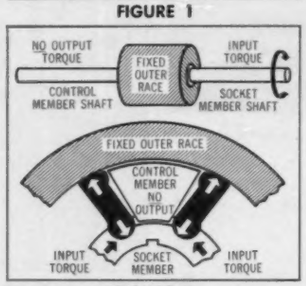


FIGURE 3

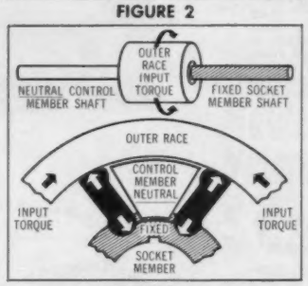


FIGURE 4

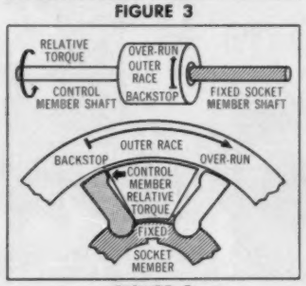


FIGURE 5

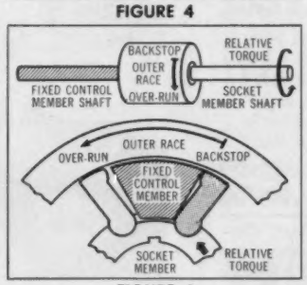


FIGURE 6

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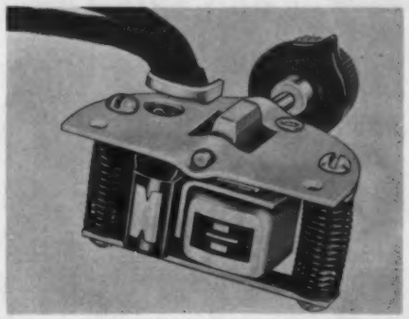
4-Track Stereo Conversion Kit 325



The WR-60 kit converts all Wollensak and Revere monophonic and 2-track stereo tape recorders to 4-track stereo. It consists of a 4-track stereo record/play head and a 4-track stereo erase head mounted in a head-shifting mechanism. The model TLB3 record/play head in the unit is a professional-quality, fine-gap head of laminated construction, and provides high-fidelity playback of pre-recorded tapes. Rotation of shifter control knob provides three vertical positions of head assembly, permitting playback of both 2 and 4-track prerecorded tapes and recordings of 4 monophonic tracks on a single tape. Also, sound-with-sound recordings can be made with a single recorder. Unit is supplied completely wired and assembled for ready installation in tape recorder.

Nortronics Co., Inc., 1015 S. 6th St., Minneapolis 4, Minn.

Portable Electric Sprayer 326

A refillable "aerosol" sprayer for manufacturing, maintenance and service operations is designed for low-cost spray-on application of light oils, water, lubricants, rust inhibitors, sealers, coatings, coolants, adhesives, dyes, disinfectants, deodorants and other applications. The unit is said to eliminate the price of packaging from the cost of spraying. Sprayer is small in size, measuring 6¼ inches tall and 2½ inches in diameter, and weighs only 12 oz. Other features include a permanently lubricated motor and sealed-in shock-proof head.

Burgess Vibrocrafters, Inc., Commercial Products Div., Grayslake, Ill.

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Add this Low-Cost brake to your small engine designs

This rugged 5" brake adds the control you want for these small engine designs . . . And at the price to keep your design in the market where it belongs.

OPERATION
A lever actuated cam forces the lined brake shoes apart and against the inside of the revolving brake drum. Springs return the shoes to their original position when pressure on the lever is released.

INSTALLATION. This brake lends itself to a varied method of installation, depending upon preference and the vehicle construction. Mounting plates of the brakes are all the same; this makes for quick, easy installation. Mounting plate bolt circles vary to meet applications and may accommodate flange type bearings.

ATTACHMENT. The brake drum may be welded or fastened to the sprocket, wheel hub or adapter flange with capscrews; it revolves around the stationary brake mechanism fastened to axle.

SIZES. This 5" brake is new to the Fairbanks-Morse line of small engine accessories. Available in different bores and widths . . . and an adapter for mounting on axles with set-screws and keyway. For more information about this brake, or the other small engine clutches, transmissions and accessories, write: Fairbanks, Morse & Company, Magneto and Engine Accessories Division, Beloit, Wisc.

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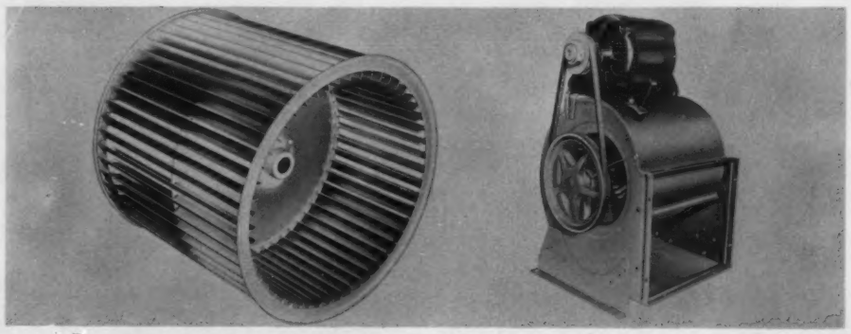
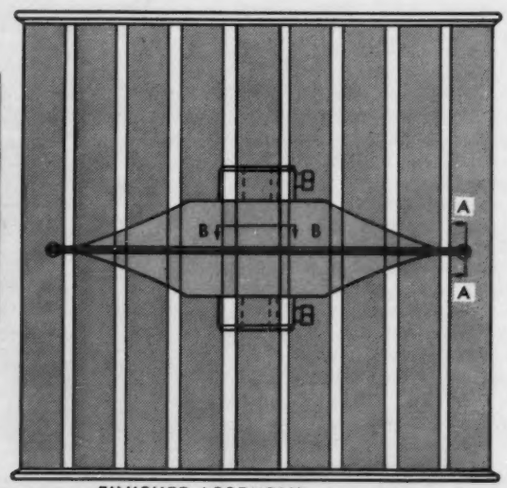
Redesigned Blower Wheel Assembled

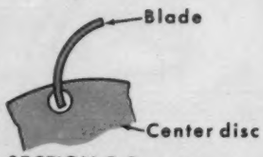
E. J. Stefanides, Central States Editor



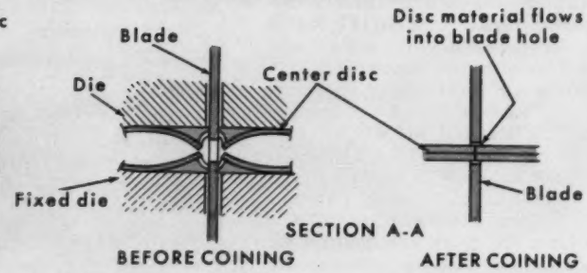
CENTRIFUGAL BLOWER AND BLOWER WHEEL. Blower is of high-volume, overloading type with forward-curve wheel. Wheel was redesigned to be assembled by spin and press forming method which anchors center of blade span and allows increased speed for increased capacity and pressure without changes in basic design.



FINISHED ASSEMBLY



SECTION B-B



HUB ASSEMBLY begins by placing center disc halves in cage formed by assembly of blade and end rings. Each blade fits into individual center disc slot. Hub tabs are then flattened by pressing between coining - die halves, tab material flows into anchor locking blades to hub. Finished wheel is balanced in dynamic balancing machine. Balancing is accomplished by addition of sheet metal weights.

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by Spin and Press Forming

The stamped parts of a redesigned blower wheel are assembled by spin and press forming of the end ring and center disc material.

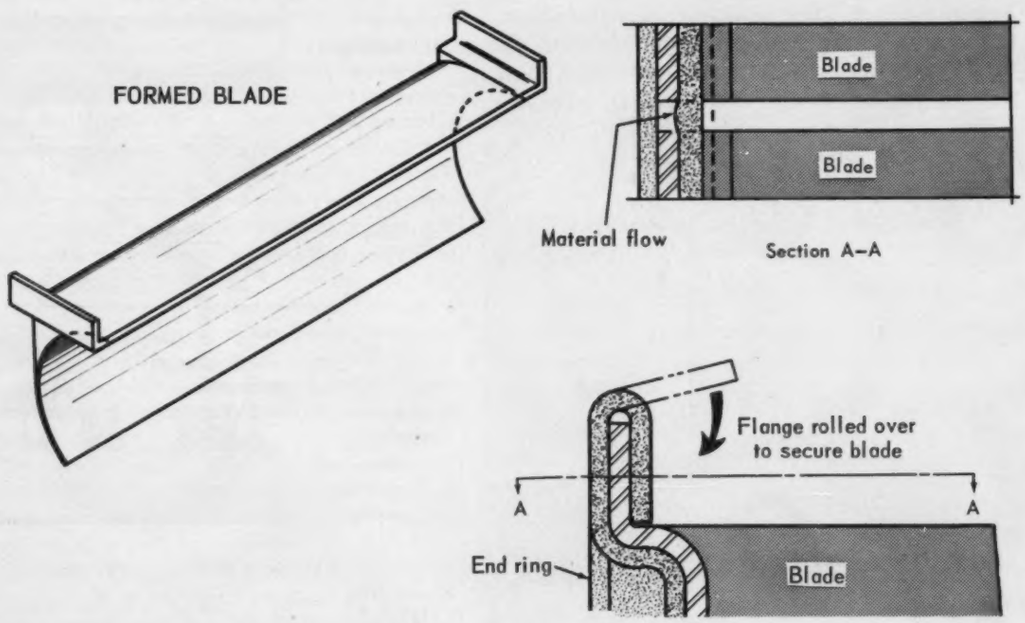
There are several advantages resulting from this construction over the previous designs. First, the method is adaptable to a variety of different diameter and length wheels and requires less tooling than the previous design. Second, it allows the same design and tooling to be used for both steel and aluminum wheels. Third, it allows for a design of maximum economy of material in stamping.

Finally, it mechanically locks the center of the blade to the center discs allowing the maximum rated speed of the wheel to be increased 50 percent. This results in 50 percent increase in capacity and 125 percent increase in static discharge pressure without changing the basic design or dimensions of the wheel.

The blades are stamped individually and formed to the proper contour with a locking tab on each end and an anchor hole in the center of the blade span. The blades are assembled to the stamped end rings by spinning a flange down over the tabs. During the spinning process some of the end ring material flows between the tabs, permanently locking the blades.

The center disc is made of two conically shaped stamped pieces which have lanced edges bent up into tabs. The center discs are placed inside the cage formed by the spin assembling of the blades and end rings. Tabs on the edge of the hub are then flattened by pressing between coining dies in a hydraulic press. As the tabs are flattened, some of the material flows in the anchor hole, permanently locking the blades to the hub. Flow of material during wheel assembly permanently fixes the very critical position and angle of incidence of the blades to assure maximum efficiency during the life of the wheel.

This blower wheel was designed by the Lau Blower Co., Dayton, Ohio, and is incorporated in its line of centrifugal blowers.



WHEEL ASSEMBLY begins when blades are placed in slotted mandrel. End rings are then slipped over end of blades and entire assembly rotated in special spinning machine. Rollers are brought to bear against end ring flanges, spinning them down over blade tabs. End ring material flows into spaces between tabs, permanently fixing blade position and angle.

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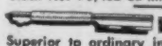

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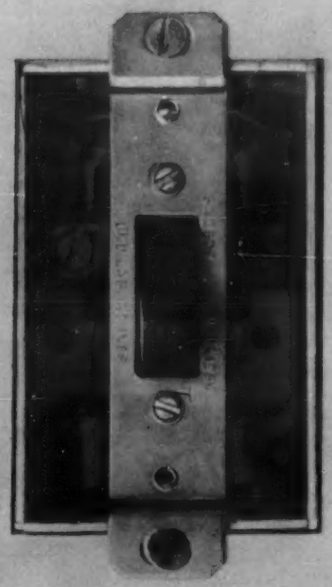

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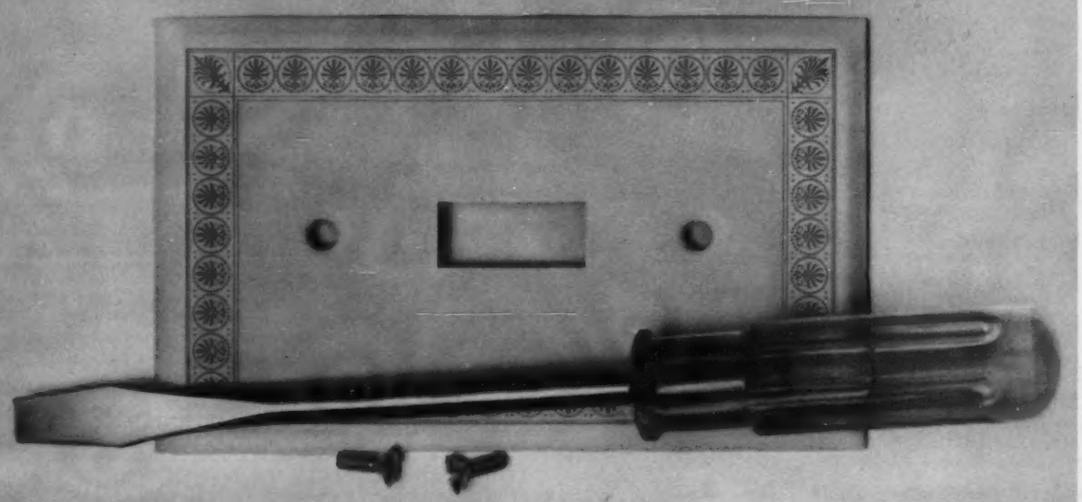

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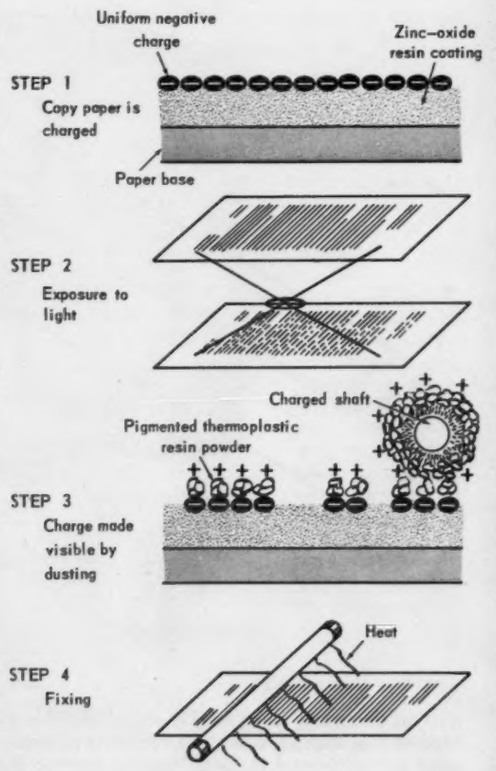
Coated Copy Paper Reproduces

Lars G. Soderholm, Midwest Editor

A new office copying machine reproduces the original document through differences in electrostatic charge on the surface of an especially coated paper. Light, as projected through the original when it is fed into the machine, causes the coated paper to release its initial charge in proportion to the intensity of the light striking it. Positive, charged black powder particles then are dusted on the charged copy paper by a magnetic brush to produce a visible image.

There are four basic steps involved in the reproduction of a document or photograph by the copying unit. All of these steps take place in the machine in a matter of seconds. In the first step, the special copy paper is given a blanket charge over its entire surface. This copy paper has an ordinary paper base coated with a mixture of zinc oxide pigment in a resin binder. The resin acts in somewhat the same manner as the dielectric medium of a condenser.



through Varying Surface Changes

The second step occurs when the charged paper is exposed to light. As light strikes the coated paper, which now has a negative charge on its surface, the electrons are moved to action corresponding to the amount of light that strikes them. In the lighted portions of the paper, the electrons migrate elsewhere, leaving these regions with a lesser electrostatic charge.

The third step in the reproductive process is the development of the charged areas into a visible image. This is done with a magnetic brush that dusts the paper with a pigmented thermoplastic resin powder. The magnetic brush uses iron powder which forms into longitudinal bristles in the magnetic field. Because of frictional electrification, the black powder assumes a positive charge while the iron bristles assume a negative charge. When the powder is wiped across the exposed copy paper, the positively charged powder particles cling to the areas that are most highly charged with negatively-charged electrons. This is the area that was not exposed to light so a positive image is formed.

The final step in the reproducing process is the fixing of the image to provide a permanent copy. Fixing is done with infrared radiation or heat. Under heat the pigmented thermoplastic resin melts and becomes fastened permanently to the paper.

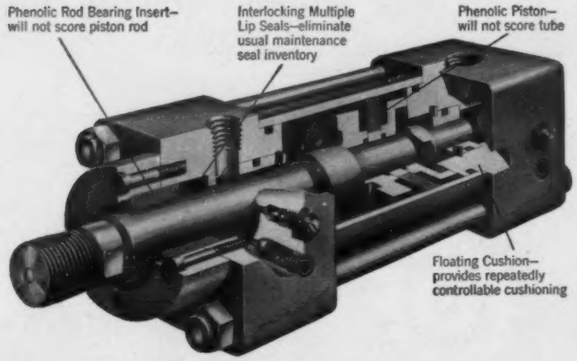
In normal copying, high contrast is desired. This is obtained with the type of copy paper usually supplied. For copying photographs, a low contrast paper will be available.

The "Electro-Stat" desk-top copier is made by the American Photocopy Equipment Co., Evanston, Ill., under license from the Radio Corp. of America and was developed through joint research with the Sherwin-Williams Co., Cleveland, Ohio.

Fluid Circuitry News from Westinghouse

Industrial Product Division expands line

The Petch line of high quality air and hydraulic cylinders is now part of the line of Westinghouse Fluid Circuitry components. This acquisition makes it possible for us to offer industry the *most complete line* of air and hydraulic components for control systems to automate industrial production operations.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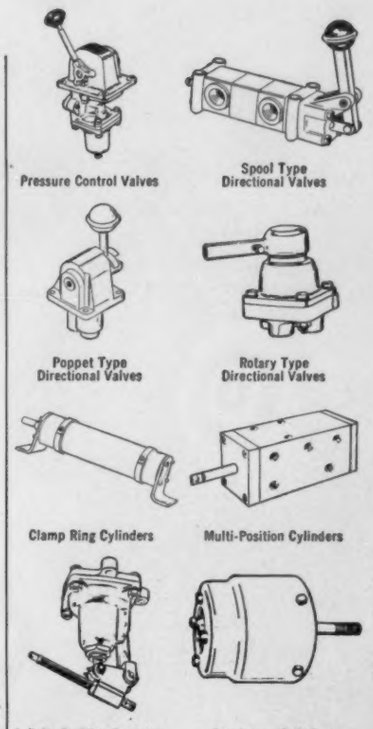

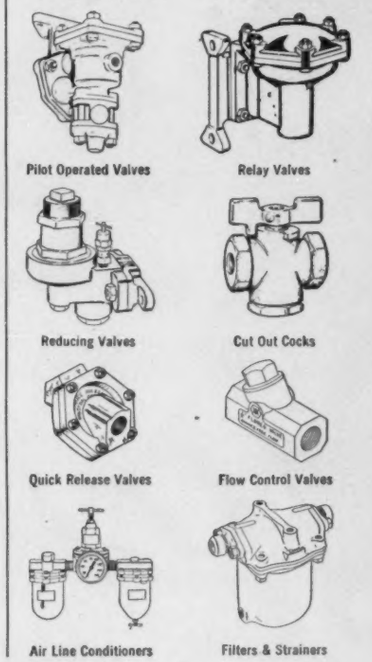

WESTINGHOUSE AIR BRAKE COMPANY
INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

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DESIGN DATA NEWS

Maximum Force Requirement for Punching of Holes

Richard Wadler, Mechanical Engineer, Raytheon Co., Bedford, Mass.

The nomogram represents the equation

$$F = 1.25 \pi Dt S_U$$

Where:

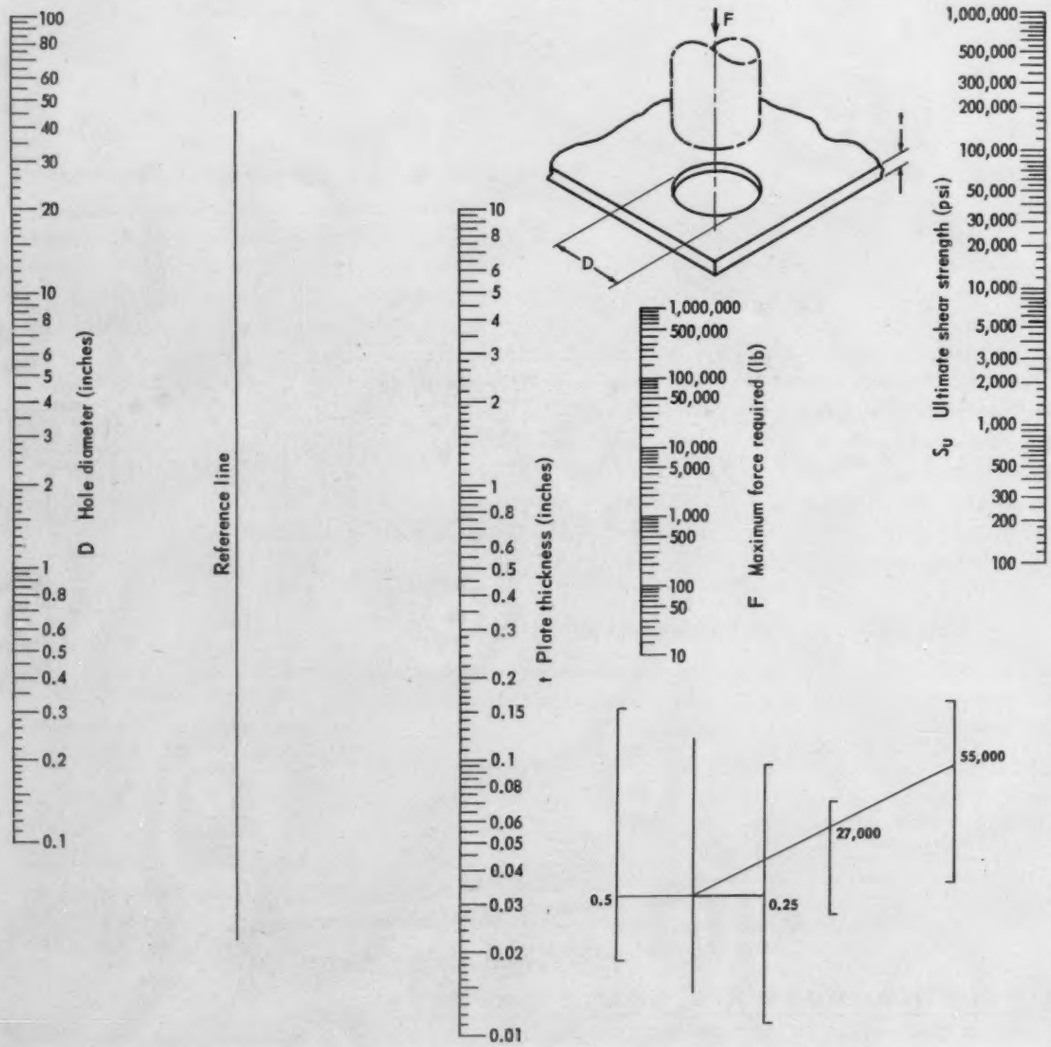
- F = maximum required force to punch the hole, lb
- D = hole diameter, inches
- t = thickness of plate, inches
- S_U = ultimate shear strength of the plate material, psi

Example:

Find the maximum required force to punch a 0.5-inch diameter hole in a 0.25-inch thick plate. The ultimate shear strength of the plate material is 55,000 psi.

Solution:

Align D = 0.5 inch with t = 0.25 inch, intersecting the reference line. Align this intersection with S_U = 55,000 psi and read F = 27,000 lb.



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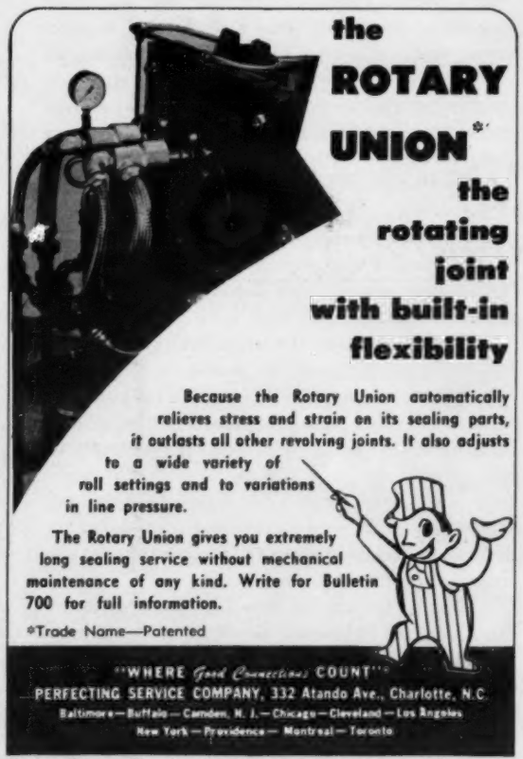
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SPACE HEATING REQUIREMENTS
Since Therm-O-Lab sprayed-on elements are only .015" thick and weigh less than one gram/in², the designer can put heat exactly where needed . . . space acclimated to withstand acceleration, vibration, radiation and cryogenic temperatures. Its total contact to the surface provides maximum heat transfer. Therm-O-Lab offers complete heat system capabilities.
Write or wire
THERMO LAB CORP.
6940 Farmdale Ave., North Hollywood, Calif.
Thermolab element on bearing retainer of lox turbine.
Wave guide heated evenly with the Therm-O-Lab element.
Container used to hold electrolyte solution for missile battery.

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The LARGEST PRODUCER of DRY FILM LUBRICANTS...

EVERLUBE IS AVAILABLE TO EQUIPMENT MANUFACTURERS WITHOUT LICENSE OR ROYALTY

Other Specialized Coatings

EverLube 501 A bonded Teflon coating offering the extremely low frictional values of Teflon without the usual high sintering temperature involved in application.

EverLube 811 A new inorganic bonded lubricant for extreme temperature (—365 to +1200°F) safe for use in liquid propellants. The first bonded solid film lubricant successful in anti-friction bearings and ball jack screws.

EverLube 1329 Heavy duty abrasion and corrosion resistant coating. Ideally suited for use on magnesium hardware that will be subjected to corrosive atmosphere as well as wear.

EverLube 620 is the established new standard in the field of bonded dry lubricants. EverLube 620 is recognized universally as the reliable, high performance, dry film lubricant process for industry. Its ability to provide consistent reproducible low friction characteristics to machine design . . . its stability in corrosive environments . . . its ease of application at modest cost and recognized test performance by service agencies and the aircraft industry, establish EverLube 620 as the accepted new standard dry lubricant process.

Write or wire for name of facility nearest you.

EVERLUBE CORP. 6940 Farmdale Avenue N. Hollywood, California

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Heat Conduction

S. Warren Kaye, Raytheon Mfg. Co., Bedford, Mass.

The nomogram solves the equation for heat conduction:

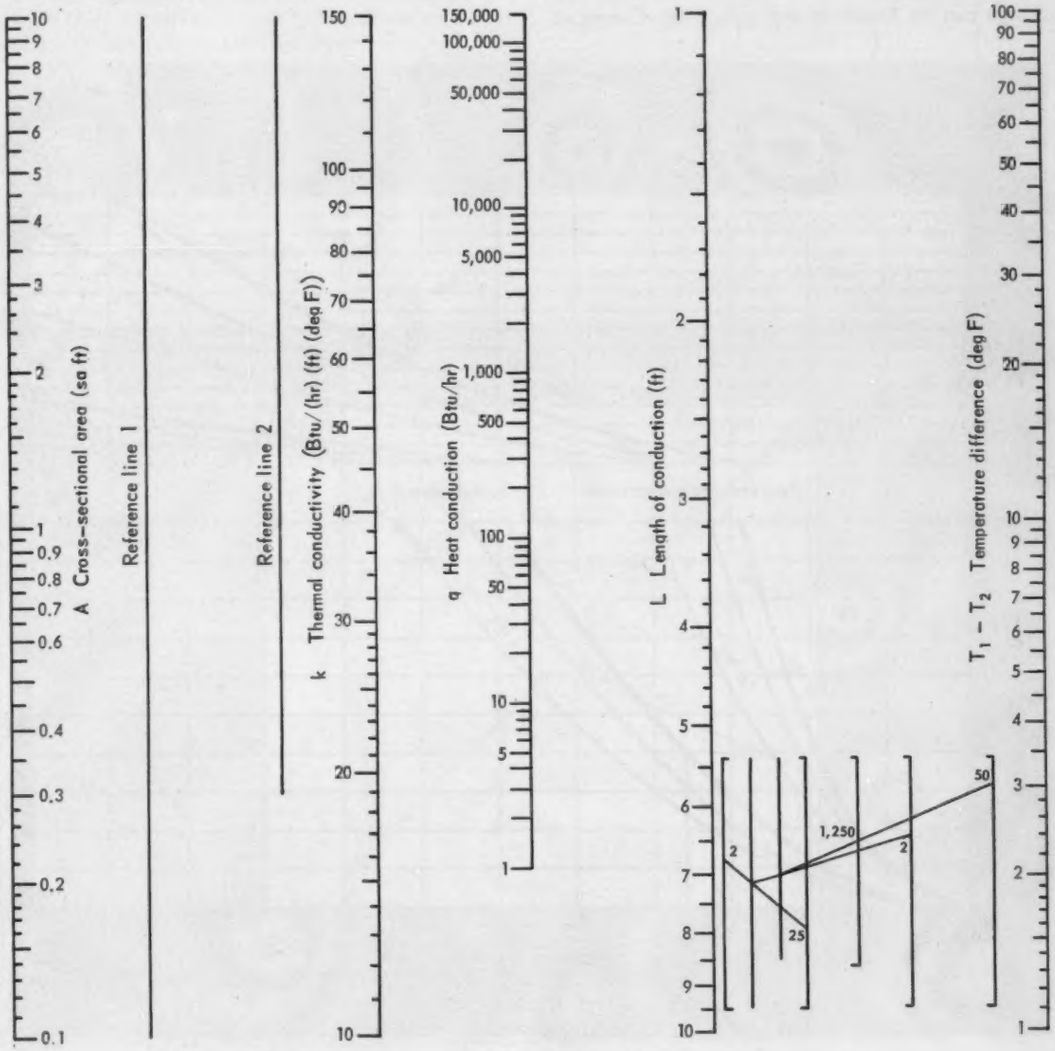
$$q = kA(T_1 - T_2)/L$$

Where:

- q = heat transfer, Btu/hr
- k = thermal conductivity, Btu/(hr) (ft) (deg F)
- T_1 and T_2 = temperatures of parallel surfaces, deg F
- L = length of conduction path, ft
- A = cross-sectional area, sq ft

Example: A steel conical shell-type structure whose cross-sectional area is 2 sq ft is attached to a steel plate 2 ft long. If surface temperatures of the shell are 400 and 350F, respectively, find the amount of heat conducted to the plate.

Solution: Align A = 2 with k = 25, intersecting reference line 1. Align this intersection with L = 2, intersecting reference line 2. Align this intersection with $(T_1 - T_2) = (400 - 350) = 50$ and read q = 1250 Btu/hr.



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Pipe Line Selection

C. G. Hackenberger, Design Engineer, Tacoma Boatbuilding Co., Inc., Tacoma, Wash.

This graph permits rapid determination of pipe in terms of ID for a given pump capacity and required flow velocity. The graph solves the equation

$$d = \sqrt{\frac{0.4085\ Q}{V}}$$

Where:

d = unknown inside diameter of pipe, inches
Q = pump delivery, gpm
V = flow velocity, fps

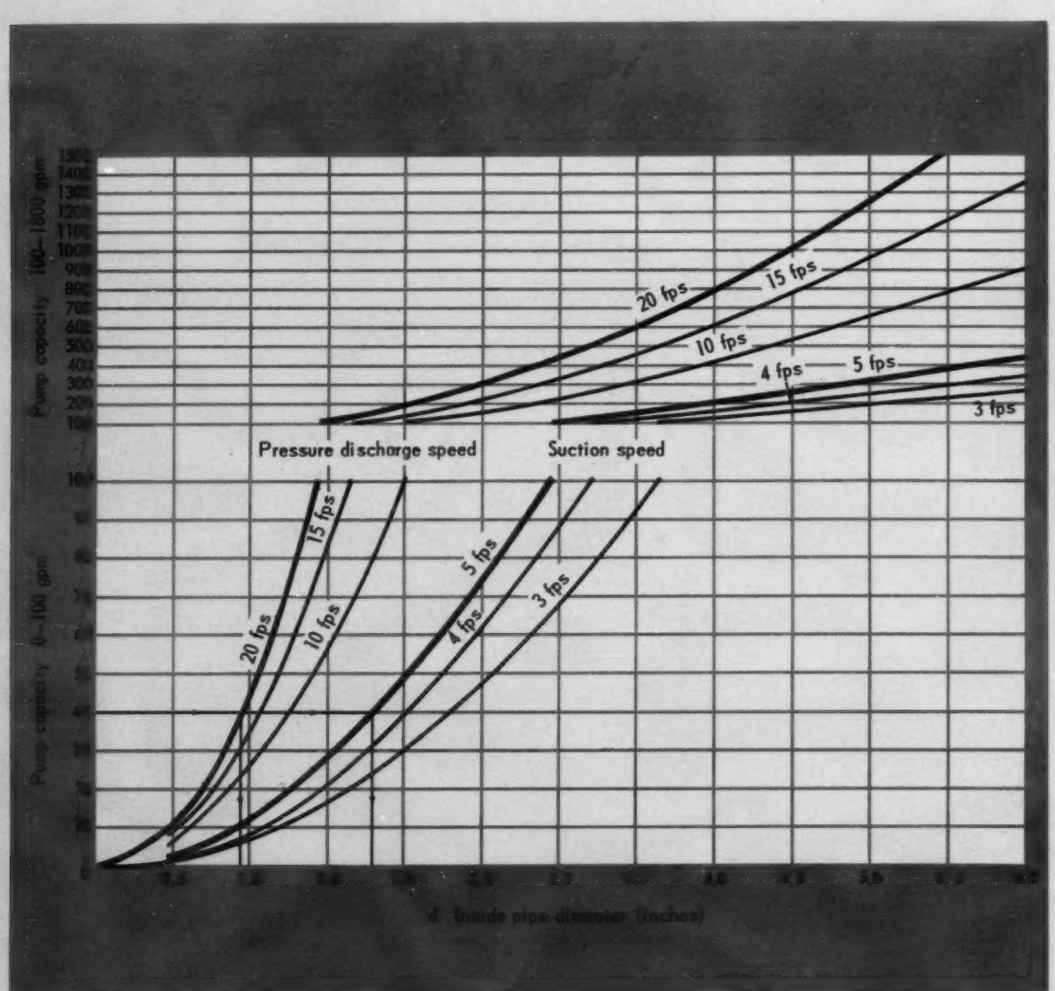
Minimum required sizes for both suction and discharge can be found in one operation. Curves of 20-fps pressure discharge and 5-fps suction represent conventional limits. Curves are plotted in two ranges, zero to 100 gpm and 100 to 1500 gpm.

Example:

For a capacity of 40 gpm, determine the minimum permissible inside diameters of pipe for suction and for pressure discharge.

Solution:

Project horizontally from Q = 40, intersecting curves for 20-fps discharge and 5-fps suction. Project downward and read 0.9 inch for discharge and 1.8 inches for suction.



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With New McGILL
Heavy Duty CAGEROL®
Cage Type Needle Roller Bearings

You need CAGEROL bearing performance if higher speeds and increased misalignment have prevented the utilization of needle bearing load capacity in your applications. CAGEROL bearings can deliver up to ten times more expected life where misalignment and increased speeds exceed the capacities of ordinary end guided needle bearings. McGill construction features tapered retainer pockets for balanced roller guidance, crowned rollers, and black oxide retainer finish. CAGEROL bearings are interchangable with all heavy duty needle roller bearings — with or without inners in two bore sizes.

Write for helpful Bearing Handbook No. H-54-C for complete data

engineered electrical products
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precision needle roller bearings

McGILL MFG. CO., Bearing Div., 203 N. LAFAYETTE ST., VALPARAISO, IND.
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Just Out! Just the ticket to cut cost!

ROSS CUB

NEW SPEED CONTROL VALVE
⅛" and ¼" pipe sizes in stock now!

Now a speed control valve that regulates your cylinder movement with precision and sureness, but which lists at $3.00 and $3.25. And despite its lower costs, "CUB" features the same high quality of design and workmanship you've come to expect from Ross. "CUB'S" design stresses trouble-free operation and easy maintenance. CUB is small, aluminum and lightweight. If you use speed controls, by all means call your Ross representative or write us.

ROSS OPERATING VALVE CO.
106 E. Golden Gate Ave. • Detroit 3, Michigan
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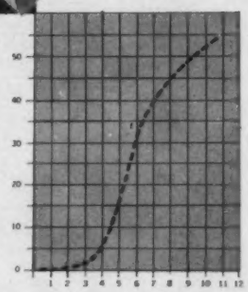
WILL THIS SHUTOFF VALVE SOLVE YOUR PROBLEM?

The six features of this metering valve, A90106, can be adapted to meet your requirements.

Pressures up to 6000 psi. *Pressure drop* extremely low at full open. *Media* air nitrogen, helium, hydraulic fluids. *Zero leakage* both internal and external. *Low handle torque* 5 inch lbs. maximum. *Simple dis-assembly* from front of panels on test stands. *Sizes* from ¼" to 1½" AND, or flange ports.



TYPICAL CURVE - Vertical figures show standard cu. ft. per minute air flow. Horizontal figures show revolutions of handle on valve.

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Log Mean Temperature Difference Correction Factor

David P. Costa, Mechanical Engineer, Naval Material Lab., Brooklyn, N. Y.

In heat transfer calculations, the log mean temperature difference (LMTD) is commonly utilized rather than the arithmetic mean temperature difference (AMTD).

$$\text{LMTD} = \Delta t_i - \Delta t_f / 2.3 \log_{10} (\Delta t_i / \Delta t_f)$$

$$\text{AMTD} = \Delta t_i + \Delta t_f / 2$$

Where:

Δt_i = temperature difference, initial

Δt_f = temperature difference, final

The accompanying chart allows determination of LMTD by multiplication of AMTD by a coefficient based on the temperature differences involved.

Example: If a heat exchanger exhibits conditions as shown in Fig. 1, determine LMTD.

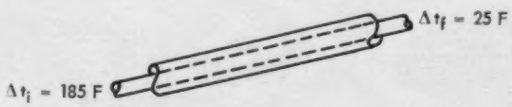
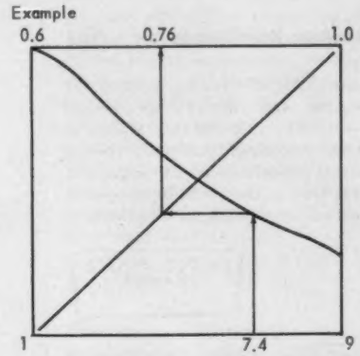
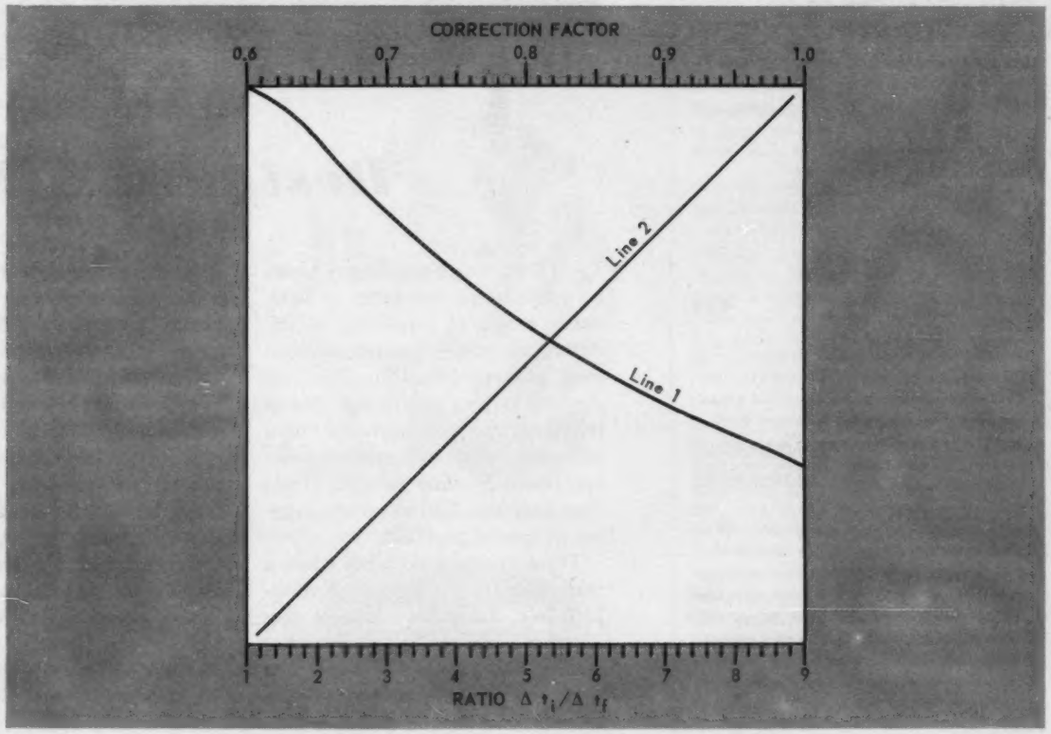


Fig. 1



Solution: Ratio $\Delta t_i / \Delta t_f = (185)/(25) = 7.4$. Enter chart at Ratio = 7.4, projecting vertically to Line 1, horizontally to Line 2, thence vertically to Correction Factor = 0.76. Multiply AMTD = (185 + 25)/(2) = 105 by correction factor 0.76. Therefore, LMTD = 79.8.



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NEW LITERATURE

To obtain copies of numbered literature . . . circle appropriate number on Reader-Service card.

Space-Age Psychology 451

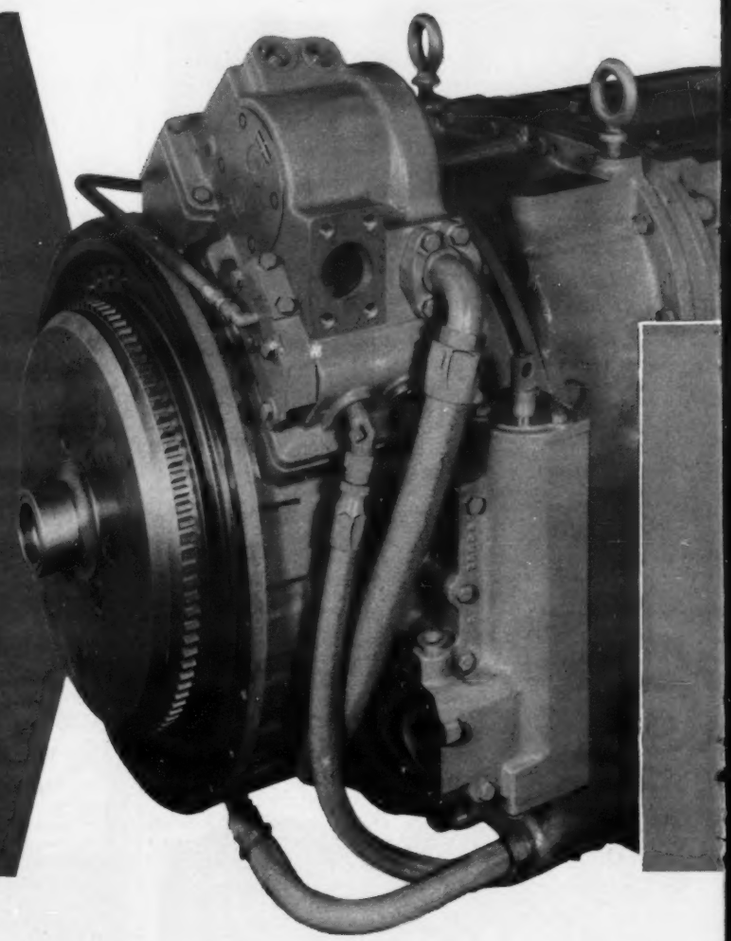
A compilation of cartoons spoofing the Automation Age. The 24-page booklet bears the sober title "Further Studies in Space-Age Psychology". Carefully selected to provide a light-hearted and slightly irreverent look at the world of computers, automation and missiles, the cartoons have

been collected from a variety of sources. Those who work in or are interested in the computer and telemetry fields will particularly enjoy this new collection of cartoons. Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

Drafting Templates 452

Carries photographs and description of 115 templates offered by the manufacturer. Twelve templates in the electrical section have every symbol used in every field of electricity and electronics. There are 23 different ellipses shown. Eleven templates in the mechanical engineering field range from screw threads to gears, nuts and bolts. Twelve templates of a general nature include, among others, metric and decimal circle templates, in addition to a large and small circle template, a square template and diamond and triangle templates. Fourteen lettering templates have block letters, slanted letters, modern type, neographic type; all pretty and useful too. Rapidesign, Inc., P. O. Box 429, Burbank, Calif.

NEW Torque Converter and Constant-Mesh Transmission



Designed SPECIFICALLY for

TWIN DISC, which introduced America's first torque converter in 1936, has a wealth of experience in designing converters for such applications as construction machines, oil rigs and logging equipment. But in designing the 18″ converter for a new power-shift transmission package for heavy-duty vehicles, Twin Disc engineers had to solve a number of special problems.

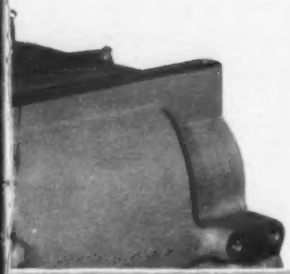
There are long stretches when a truck does not require torque multiplication. For peak efficiency during these periods, Twin Disc has included a freewheeled stator in its new single-stage converter. When the need for torque multiplication falls off, the speed of the pump wheel approaches that of the turbine. This reduces the reaction force on the stator to the point where it freewheels. The converter becomes in effect a fluid coupling, and the result is higher efficiency.

This efficiency can be stepped up still further under 1:1 ratio conditions by means of a front-end lock-up clutch on the converter. Engagement of this clutch provides direct drive performance.

Also featured in this new converter is a hydraulic retarder. Loads on truck service brakes keep going up, yet their capacity is limited by the available brake space at the wheels. The hydraulic retarder absorbs a high percentage of the vehicle's kinetic energy, dissipating it in heat. This saves wear on the brakes and permits safe, controlled descents at higher speeds.

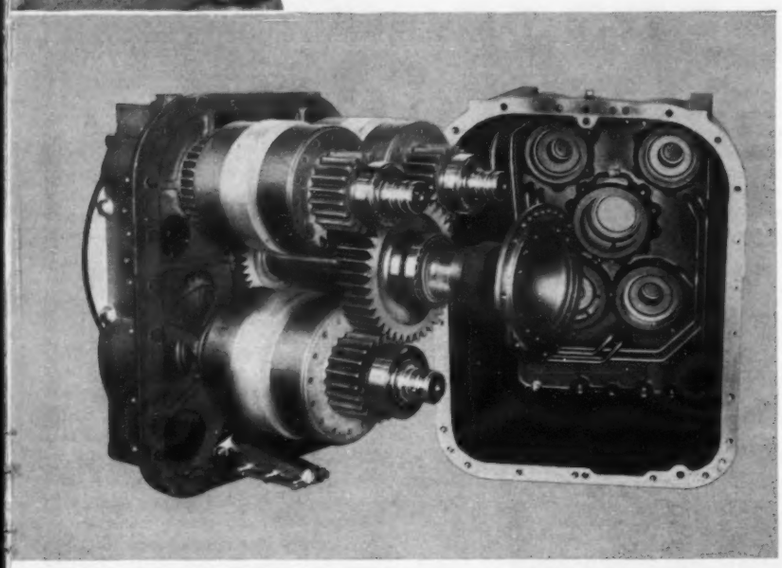
The torque converter can be supplied as a separate unit or as part of a converter-transmission package with the new Twin Disc TA-51-2000 Power-Shift Transmission. This transmission permits gear-shifting on up-hill hauls without power interruption or loss of momentum.

The TA-51-2000 is a straight-through countershaft unit with constant-mesh gearing. Shifting in all ranges at full engine power is

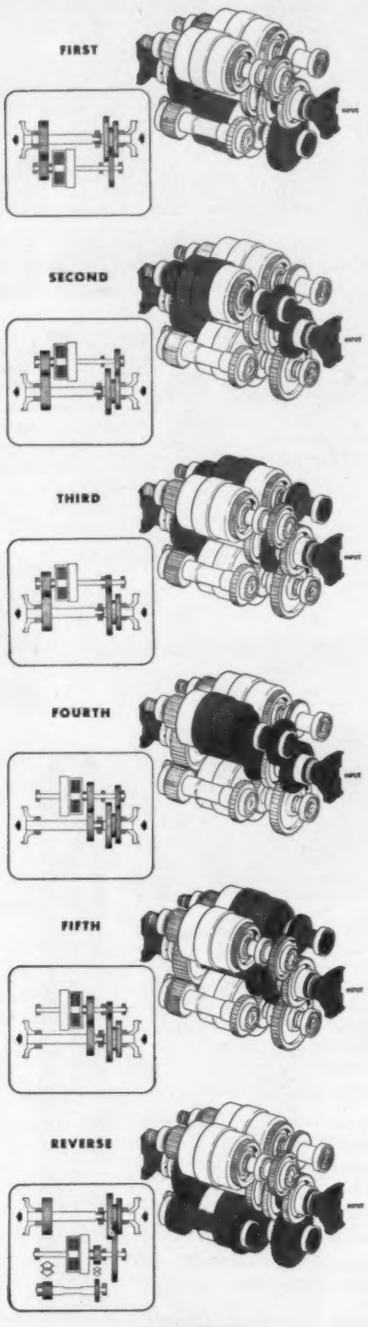


Three models available in the TA-51-2000 Series

Model No.	Max. HP	Max. Torque (lb.-ft.)	Max. Speed (rpm)	Ratio Spread
TA-51-2001	420	1050	2500	5.93:1
TA-51-2002	420	1050	2200	6.80:1
TA-51-2003	420	1050	2800	5.45:1



Transmission Power Flow



Vehicles...by TWIN DISC

through multiple-disc, oil-cooled, hydraulically actuated clutches. There are five forward ratios and one reverse. A modified version, called the TA-33-1600, has three forward and three reverse speeds. Four different drop boxes are available to meet special drive requirements.

The converter is used only in the first two ranges to get the load moving or to meet low-speed tractive-effort demands. The second ratio has two selector positions, one for drive through the converter and the other for use when the converter is locked up. Lock-up range thus extends from the second through the fifth ratio. Where desirable, a manual over-ride can be provided to permit converter drive in all ranges.

A noteworthy feature of these converter-transmission packages is interchangeability of parts. Gearing can be easily changed to match engine modifications, thereby simplifying inventories and service.

Twin Disc Clutch Company, Racine, Wisconsin; Hydraulic Division, Rockford, Illinois.

ENGINE TO AXLE WITH... TWIN DISC POWER TRANSMISSION EQUIPMENT

Circle 74 on Reader-Service Card for more information

Stainless Steel Selection Guide 453

If you have ever been confused by the sheer number of stainless grades available, their differing analyses and the suitability of one over another for a specific application, this booklet can help you. It contains all basic information needed for a good general background in stainless steel. Condensed into 16 handy pages, the approach is simple and straightforward, taking you through the stainless grades, their analyses and family relationship, physical and mechanical properties. It also covers corrosion resistance and discusses the various forms of corrosive attack. Allegheny Ludlum Steel Corp., 20th Floor, Oliver Bldg., Pittsburgh 22, Pa.

Plastic Engineering Data 454

A 20-page illustrated booklet published for product designers and plastic fabricators. Complete physical and chemical data, including performance charts, are given on this plastic, which was specifically developed for injection molding and is currently being used for home appliances, auto parts and a range of other applications. Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.

Buyers and Designers Guide 455

Provides engineering data on square, rectangular and round steel tubing for structural applications in the construction of buildings, machinery, furniture, fixtures, appliances, truck bodies, racks and supports. Advantages of structural tubing over other steel shapes are listed. Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill.

Self-Locking Blind Fasteners 456

A new solution to the problem of blind fastening is offered in a product bulletin. It covers the SPS Davis press nut. The literature reviews the principle of operation of the one-piece, flush-mounting nut; suggests possible applications, principally in airframe, missile and comparable sheet-metal applications; and details general specification data. Standard Pressed Steel Co., Jenkintown, Pa.

SAVE COSTS with STANDARD LIQUID TAYLORED TO YOUR SPECS

DASH POTS and SPRING SHOKS

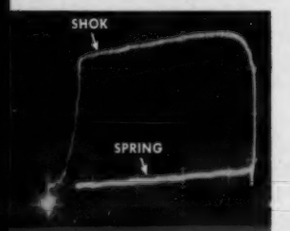
NEW COMPLETE LINE OF HIGH CAPACITY STANDARD DASH POTS are available for immediate delivery from standard Liquid Shok components. The energy absorption range of these Taylor Liquid Dash Pots is identical to Taylor Spring Shoks or from 50 to 5,250,000 inch pounds. Above photo with hand shows a typical Taylor Liquid Dash Pot used on a military radar antenna. Photo with man is a Spring Shok for railroad car buffer.

NOW for the first time standard Dash Pots, Spring Shoks and Springs are available to meet your exact energy requirements. With the unique Taylor patented tubular piston design, standard off-the-shelf components provide for variation in capabilities at low cost.

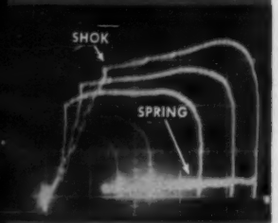
Complete line of standard models includes the widest range of energy absorption and/or spring forces to fit specific envelope areas and SAVE WEIGHT, SPACE AND COST. That is why it pays, in multiple savings, to standardize on Taylor Liquid Compressible Devices.

Oscilloscope photos show capabilities of Taylor Liquid Devices from the standard line

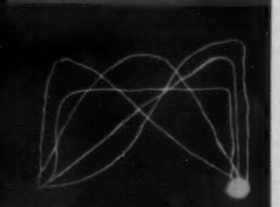
ALL TAYLOR LIQUID COMPRESSIBLE DEVICES SHOWN ARE ASSEMBLED FROM STANDARD PARTS.



SPRING PLUS SHOK IN 1 UNIT
Used on aircraft arresting gear

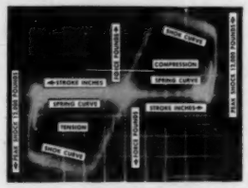


MINIMUM IMPACT OR SHOK FOR ANY ENERGY INPUT CONDITION
Used on carrier applications



ANY SHAPE ENERGY ABSORPTION CURVE
Used on electric circuit breakers

OSCILLOSCOPE photograph of the Taylor Tension-Compression Spring Shok shows energy absorbed under shock curve up to 80% of square card and spring capabilities to reposition fighter plane arresting hook shown at right. This unit provided 27.5 pounds weight reduction in 1/5th the space. Taylor Liquid Spring Shoks are designed to absorb and store energy in both directions. Double acting piston system uses same liquid to provide identical or different energy in tension and/or compression. Any desired shok or spring curve is available to meet exact requirements.



ALL TAYLOR SPRING SHOKS PROVIDE:

- Infinitely variable spring and/or dash pot energy capabilities from 50 to 5,250,000 inch pounds.
- Controllable return velocities from milliseconds to days.
- Tension, compression, or both.
- Minimum weight and space in direct acting, integral units.
- Original performance even after long storage.
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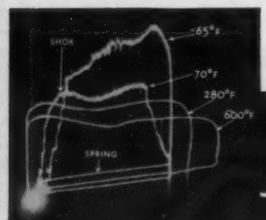

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Taylor Liquid Springs have the highest forces ever produced in a single, self-contained unit. For example, the above 2 foot high by 1 foot diameter 1,000,000 pound spring with 200,000 pound preload will support 3 large locomotives. In addition, Taylor Liquid Springs have been designed up to 42,000,000 pounds.

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(On Tonawanda Island in the Niagara River)

LITERATURE . . .

Electronic Kits **457**

Transistor radios, code oscillators, solar-powered devices and a tester are a few of the 18 projects that can be built with the "Electronic Laboratory" illustrated in this catalog. Superex Electronics Corp., 4 Radford Pl., Yonkers, N. Y.

Plastic-Coated Packaging **458**

A file folder containing a variety of plastic-coated packaging materials. Included in the folder are samples of pouch paper, blotter paper, gold metallic and a number of Krafts, all coated with "Marvelene" polyethylene. Marvellum Co., Holyoke, Mass.

Circuit Breakers **459**

Complete descriptions, wiring diagrams, dimensions and selector tables for circuit breaker load centers are contained in a 20-page catalog. A simplified guide to panel selectors is featured, as well as a description of panel catalog numbering system. Full-page selector tables are included for: single-phase main lug, split bus and main breaker panels; and for three-phase main lug panels. Also listed are meter socket load centers. Bryant Electric Co., Box D, Barnum Station, Bridgeport 2, Conn.

Electrical Control Systems **460**

A 6-page brochure showing typical electrical control systems installations for general industry, special equipment units and standard fabrications. SEMCO Electric Controls, Inc., P. O. Box 7624, Houston 7, Tex.

Multiple-Pin Connectors **461**

An illustrated 6-page folder describes a line of pin-and-socket type multiple connectors. Folder details electrical and mechanical characteristics. It also lists features of the 5 types of contacts available and features of connector shells and inserts. Amp, Inc., Harrisburg, Pa.

Circle 75 on Reader-Service Card

Lepel

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Lepel induction heating equipment is the most practical and efficient source of heat developed for numerous industrial applications

Typical Induction Heating Applications

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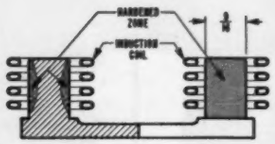
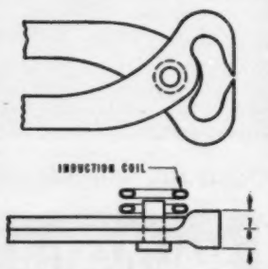


Bosses on part shown are locally hardened to increase resistance to wear and plastic yielding. Surface hardening by induction provides hardness pattern indicated and hardness of Rc 57/59 for 1040 steel when quenched in water.

Our engineers will process your work samples and return the completed job with full data and recommendations without cost or obligation.

Hot Forming Aids Production Assembly of Nippers



The ends of high-strength steel rivets are selectively heated to 1700° F for hot upsetting. Design of coil permits movement of upsetting tool through the coil.

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CHICAGO OFFICE: 6246 WEST NORTH AVE.

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Aircraft-Missile Components Systems **462**

A 71-page, 855-item catalog listing instrumentation and other electromechanical components. The catalog, No. 4-60, includes equipment manufactured by leading companies such as Minneapolis-Honeywell, Bendix, AiResearch, Kearfott, Kollsman, Statham, CEC, Daystrom Pacific, Norden Ketay, Wiancho, Giannini and many others. AST Co., Inc., 150 Fifth Ave., New York 11, N. Y.

Electronic Information Searching **463**

An 8-page brochure describing an electronic system of searching metallurgical and related literature for specific information on subjects. The brochure discusses the mechanized way to reduce research costs and increase accuracy, speed and effectiveness. Also of interest is a description of how subscribers may receive, every two weeks, information on anything published in the preceding two weeks on their field of interest. American Society for Metals, Metals Park (Novelty), Ohio.

Drive Tensioners and Idlers **464**

A 4-page catalog sheet describing base-mounted drive tensioners and shaft-mounted bronzed bush idlers. Line drawings show mounting dimensions and typical installation of both units. Tips on idler usage are also included. Brewer Machine & Gear Co., 1441-43 N. 2nd St., St. Louis 6, Mo.

Computer Systems **465**

A 9-page report describing application of the "DYSTAC" dynamic storage analog computer to determination of complex chemical equilibrium conditions and composition. At a given pressure, the report shows, system equilibrium is dictated by heat input to the reactor. In this report is a description of how the computer uses this criterion to establish equilibrium conditions as a function of temperature. Report lists instrumentation required; diagrams complete equipment interconnection for "reactions", "heat balance" and "equilibrium composition"; indicates mathematical derivations and equations; and describes installation and operation of the equipment. Computer Systems, Inc., Culver Rd., Monmouth Junction, N. J.

FHP Motors **466**

A specification sheet detailing design features of a split capacitor fhp a-c motor. The easy-to read literature contains full size, speed and power specifications for the new motor series, which is available in ratings from 1/15 to ½ hp. All specifications are presented with photographs, charts and engineering drawings for maximum clarity. Leece-Neville Co., 989 Athens St., Gainesville, Ga.

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MARTIN'S USAF TITAN ICBM
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to be fitted with ON MARK Vent Connector Couplings —
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TECHNICAL PAPERS

The Artist Engineer

C. J. Freund, Dean, College of Engineering, University of Detroit, Detroit, Mich.

The great majority of engineers doubtless combine science and art in their work. But the two types have to be differentiated sharply in order to visualize completely the structure of the engineering profession.

For example, a scientific engineer, or his client or employer, may feel that it is possible to capture the sun's energy as it arrives on the earth's surface. The scientific engineer then may try to conceive solar heat or power applications.

Usually he does not like to proceed beyond the schematic diagram stage of the business. He maintains that development, design, tooling, production, testing, redesign, economic analysis, costing, selling and servicing do not concern him. Although he does serve the public indirectly, the scientific engineer thinks much more about radiation theories than he thinks about customers.

The Artist Engineer

At the schematic-diagram stage the artist engineer takes over. The artist engineer has to design the solar apparatus so that it will function. More particularly, his job is to produce a solar apparatus which will serve a purpose; it must provide a utility. The artist engineer has more to do with costs than the scientific engineer. The artist engineer has to experiment and develop. He has to evolve a design which can be produced with the available plant and production equipment, and which can be installed easily, serviced and repaired. He must provide and adapt machines and attachments; he must see to tooling; he must get his components assembled and the assembly tested.

Qualifications Of the Artist Engineer

The artist engineer must, of course, possess all those qualifications which are required of every engineer. But what special characteristics must the artist engineer have in order to succeed in his peculiar vocation? He must be familiar with the most modern engineering materials, and he must know about the sub-molecular and internal science of materials. He must be strong in thermodynamics, radiation, heat exchange, reflection, fluid flow and other technologies which pertain to his solar project.

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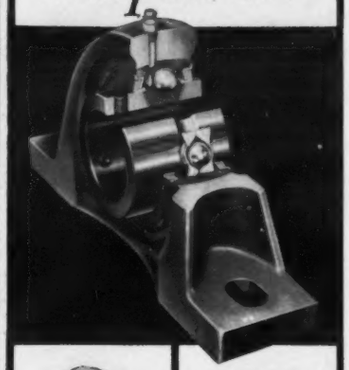

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He requires firmness, composure and confidence, and sufficient diplomacy to get on with people ranging all the way from corporation officers to common laborers.

More important, perhaps, than all of these, he has to have a special kind of intuitive judgment to make decisions when he can't get all the precise technical data he ought to have. He must know how to extrapolate beyond his computations, and his research and test results.

Equal Recognition

In spite of their competence and achievements, artist engineers have not succeeded in making their fellow engineers and the public appreciate them. The scientific engineers have done a much better job of public relations—or have had it done for them.

On the other hand, the artist engineer has been largely forgotten. He is made to appear as merely the assistant to the scientific engineer, his servant or helpmate, a sort of non-commissioned officer.

The Task of the Colleges

A balance of dignity and status between the two types of engineers should be restored. If balance is not restored, there will be no strong and able men to bridge the gap between the scientific engineer with his schematic diagram for solar apparatus, and the tool maker and production foreman who get the apparatus through the manufacturing plant.

It is up to the colleges to educate young men for the artist phase of the profession as well as the science phase.

For one thing, the faculties must extol the artist engineer. Administrators and teachers must make it clear to students that the artist engineer, the applications man, is in every sense the equal of the scientific engineer, and that the contribution of the one is as valuable as that of the other. More importantly, they must point out to the students that the artist engineer is concerned more directly than the scientific engineer with the proper function of the profession which is "ministry to the people."

Abstracted from a technical paper, "The Artist Engineer", presented at the Winter Annual Meeting, ASME, New York, N. Y.

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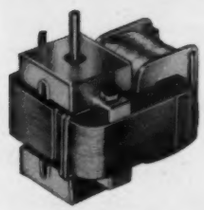

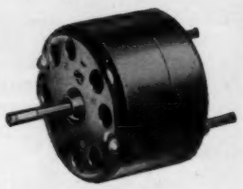

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PAPERS...

Copies of these papers may be obtained by writing to technical society indicated. Addresses follow last item.

ADEQUACY OF ICBM GUIDANCE CAPABILITY FOR A MARS LAUNCH; *William N. Spence, Northrop Corp., Hawthorne, Calif.; ARS No. 1174-60.*

A mathematical analysis of the errors involved in launching vehicles to Mars along a Hohmann orbit, using Taylor's Theorem. Functions expressing vehicle's motion as it enters Mars gravity sphere are given in closed form. Present-day ICBM guidance equipment is sufficiently accurate to place the vehicle within the near vicinity of Mars without aid of midcourse guidance.

STRUCTURAL BERYLLIUM; *B. B. Muvdi, Michigan College of Mining and Technology, Houghton, Mich.; ASTM No. 79.*

Results of an attempt to produce beryllium possessing adequate structural characteristics. Comparison of specimens of plate beryllium representing five different fabrication methods. Structurally, the best combination of uniaxial and biaxial properties was exhibited by commercial grade QMV beryllium powder which had been compacted cold and then upset hot.

SOME FACTORS AFFECTING DRY AIR CLEANER EFFICIENCY; *E. H. Farnan, Ford Tractor and Implement Div., Birmingham, Mich., and J. A. Weber, University of Illinois, Urbana, Ill.; SAE No. 216B; 75 cents; to SAE members, 50 cents.*

An evaluation of test factors affecting dry air cleaner efficiency. Determination of conditions simulating field operation. Absolute filter and air sampling methods were used. Sampling method on a diesel engine gave values that correlated with field performance.

AIR FORCE MAINTENANCE ON THE J79 ENGINE; *John H. Toeplitz, Oklahoma City Air Material Area, Tinker AFB, Okla.; ASME No. 60-AV-48; 80 cents; to ASME members, 40 cents.*

This high-performance, lightweight turbojet aircraft powerplant has opened new vistas of performance, field maintainability and overhaul. Description of the USAF experience with the J79 engine during development operations and the various military levels of maintenance.

DEGRADATION OF HIGH-TEMPERATURE LUBRICANTS; *J. J. Murray and E. P. Scanlan, Chicago Rawhide Mfg. Co., Chicago, Ill.; ASLE No. 60AM 1A-2; 75 cents; to ASLE members, 50 cents.*

Fluoroelastomers have been developed which are being applied successfully in high-temperature sealing applications involving lubricants of the ester and silicone fluid types. Description of a test program to measure interaction effects of elastomer, lubricant and metal.

BEARING LIFE ANALYSIS FOR TORQUE-CONVERTER DRIVEN POWER TRAINS; *H. B. Scheifele, Bower Roller Bearing Div., Federal-Mogul-Bower Bearing Inc., Detroit, Mich.; SAE No. 227A; 75 cents; to SAE members, 50 cents.*

A simplified graphical bearing analysis for gear trains receiving their power from torque converters. Bearing life curves are included to aid selection of the correct bearing.

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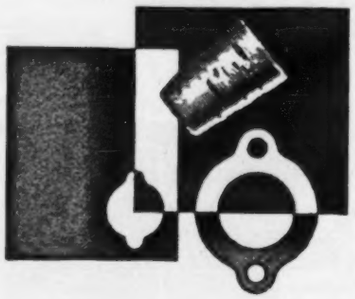

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THERMOELECTRIC ELEMENTS IN SPACE POWER SYSTEMS; *D. L. Kerr, General Electric Co., Philadelphia, Pa.; ARS No. 1277-60.*

Characteristics, potentialities and problems encountered in designing thermoelectric generators for space applications. Investigation of the "sandwich" and "side fin" types of construction and estimates of the minimum weight obtainable from each are presented for particular materials properties. A combination of the two types of construction results in the least weight.

AN INVESTIGATION OF AXIAL-FLOW-PUMP DESIGN; *Y. K. Gayed and S. Mikhail, Cairo University, Egypt, U.A.R.; ASME No. 60-WA-36; $1.00; to ASME members, 50 cents.*

Design of axial pumps is still based on single aerofoil results, modified by more recent tests on thin hydrofoils. This paper attempts to fill the need for a procedure to piece together the results of investigation on blade cascades as affecting the duty of the pump and speed limitations set up by cavitation.

AN AUTOMATIC ROOT-LOCUS PLOTTER USING AN ANALOG COMPUTER; *F. E. Liethen, USAF, Dayton, Ohio; C. H. Houpis and J. J. D'Azzo, Air Force Institute of Technology, Dayton, Ohio; AIEE No. 60-1186.*

Speed of operation is obtained from the method of root-locus plotting described in this paper. Pole and zero values are set into the computer by means of potentiometers. Families of curves are obtained readily. The major obj. 'on to the system may be that it requires one more resolver than the total number of poles and zeros of the open-loop transfer function.

THE EFFECT OF A SHOCK WAVE ON A BURNING SOLID PROPELLANT; *E. M. Landsbaum, Jet Propulsion Lab., California Institute of Technology, Pasadena, Calif.; presented at the Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland; printed by Pergamon Press Ltd., 4 & 5 Fitzroy Square, London, W. 1 England.*

A burning propellant at the end of a shock tube in the quiescent-gas zone sees a shock wave primarily as a pressure step. Burning rate is assumed to be surface-temperature-dependent. Time-dependent temperature distribution in the propellant is determined numerically. Burning-rate-time plots are given for variation of important parameters. Effect of initial burning rate is discussed.

ANALYSIS OF ELECTROHYDRAULIC VALVES AND SYSTEMS; *Roy S. Cataldo, GMC Research Labs., Warren, Mich.; ISA No. 11.*

Derivation of equations of motion of three possible configurations for electrohydraulic servo valve design and equations for position servomechanisms utilizing these values when driving a generalized load. Valve configurations differ in the manner in which the main spool is positioned. Three cases are considered.

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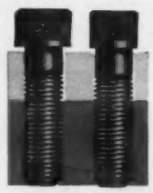

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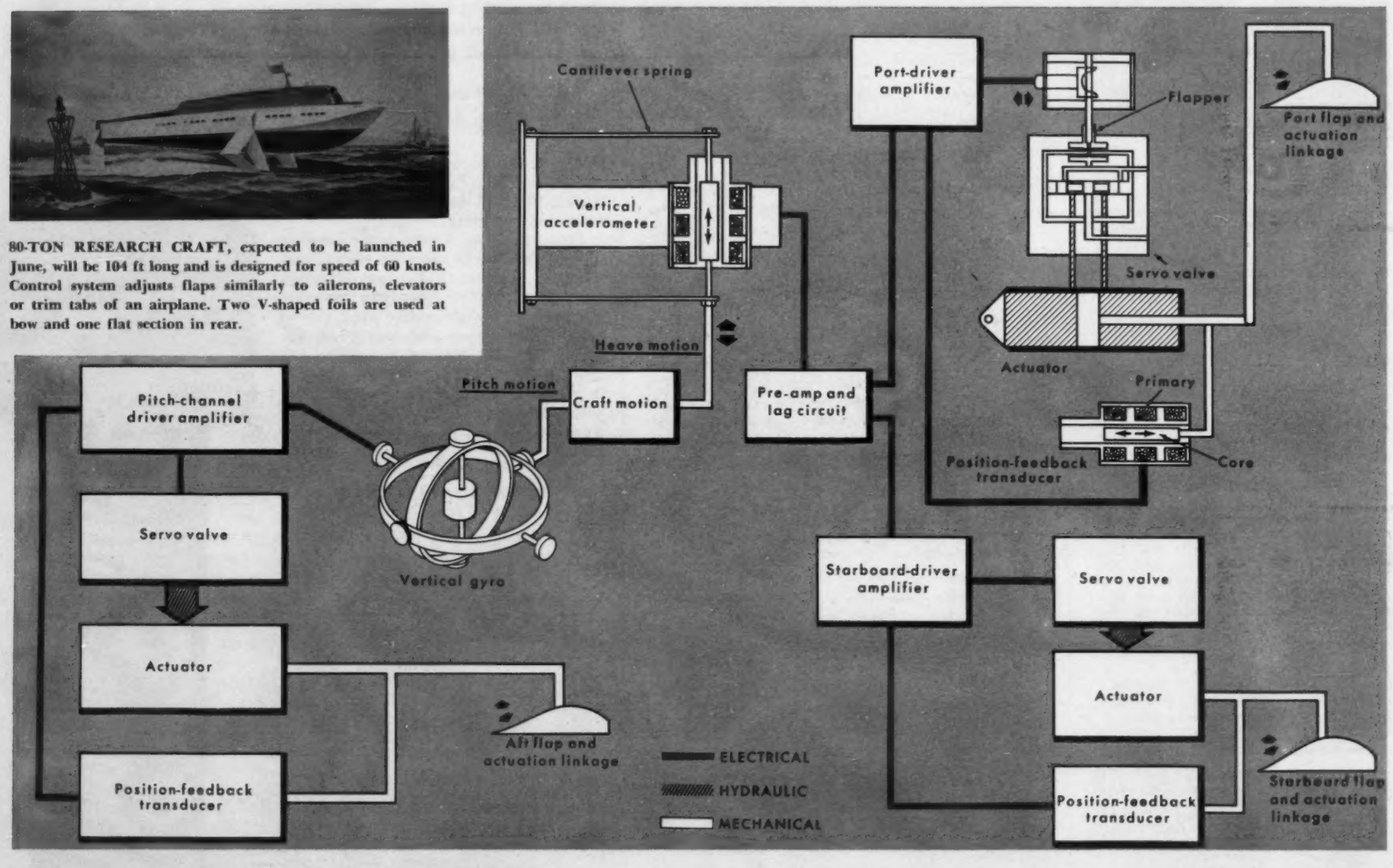
Gyro-Accelerometer System Smooths Motion of Hydrofoil Craft

Victor W. Wigotsky, Eastern Editor

80-TON RESEARCH CRAFT, expected to be launched in June, will be 104 ft long and is designed for speed of 60 knots. Control system adjusts flaps similarly to ailerons, elevators or trim tabs of an airplane. Two V-shaped foils are used at bow and one flat section in rear.



VERTICAL GYRO PROVIDES SIGNAL proportional to deviation from true vertical. Deviation from steady-state value of established pitch provides error to drive amplifier which signals electro-hydraulic servo valve to control fluid flow to actuator. Signal flow is implemented such that a positive pitching motion (counterclockwise rotation of craft) causes rear flap to move downward. A counter torque is generated about craft pitching axis which then resists pitching deviations. Vertical heave accelerations of craft are sensed by accelerometer which feeds signal to preamplifier where approximate integration takes place. Signal from preamp, proportional to vertical velocity, feeds port and starboard driver amplifiers in synchronism. Driver amplifiers in turn control two forward actuators. Forward flap position is therefore proportional to forward vertical velocity with the flaps positioning upward for vertical velocity upward. An additional lifting force thereby is generated in opposition to vertical craft motions. As actuator moves to commanded position, electrical feedback from transducers cancels input signal to amplifiers to stop actuator motion. Use of position feedback assures neutral centering of actuators in event of loss of input signal to servo valves. As a result of system operation, the heave and pitch oscillations are reduced significantly, keeping craft foilborne in heavier seas. System stabilizes craft continuously under all conditions and also tends to reduce vertical accelerations experienced by personnel.

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The stabilizing control system for a new 80-ton hydrofoil boat uses a vertical gyro and a vertical accelerometer to damp magnitude of pitch and heave motions, respectively. The system extends the foil-borne capabilities of the craft in rough seas by preventing a downward shift in craft attitude and "falling in" of the hull.

Use of a vertical gyro establishes a steady-state pitch angle. Output is then only proportional to pitch, irrespective of rate of change of the angle. This avoids potential instability that could result if, for example, a rate of change device were used. Although pitch rate control would provide satisfactory operation at low velocities, unstable conditions at higher velocities could result because of increased effectiveness of the control surfaces. While this can be corrected by automatically decreasing loop gain as a function of velocity, through use of a velocity-sensing gain changer, this approach was rejected because of added cost and complexity.

Heaving (vertical motion) is damped by a vertical accelerometer which controls actuator at the forward foils. Here again a comparatively simple arrangement is used. The accelerometer is followed electronically by an approximate integration to provide a signal indicative of vertical velocity. The signal then is fed to port and starboard driver amplifiers to control the forward actuators.

This method was chosen rather than a boat-height sensing method, which would measure actual distance between center of gravity and water surface. Such methods as pulse and continuous-wave sonic systems or RF systems indicate actual boat height. Excessive vertical accelerations and passenger discomfort could result, however, since the tendency would be to maintain boat height at a constant distance above the surface. Feedback of vertical velocity causes flap motion that opposes change in position of the center of gravity of the craft. The boat then tends to slice through the waves rather than "contour" over them, thus reducing vertical motions and accelerations.

The "Marad" hydrofoil control system was designed by Hamilton-Standard, Div. of United Aircraft Corp., Broad Brook, Conn., for the hydrofoil boat designed by Dynamic Developments, Inc., an affiliate of Grumman Aircraft Engineering Corp., Bethpage, Long Island, N. Y., builder.

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Gasket engineering

PRACTICAL TOLERANCES CAN CUT GASKET COSTS

Close tolerances in resilient gasket thickness are seldom necessary. Units with extremely close assembly tolerances can usually be sealed with compressible cork-and-rubber materials made to commercial standards.

Tolerances in gasket thickness do not become critical if the material chosen seals effectively over a wide range of compressions.

Armstrong cork-and-rubber compounds are typical of such materials. They will compress from 20% to 33% —depending on the amount of cork in the particular compound—without excessive sideflow.

The cork content of these materials makes them truly compressible. They actually decrease in volume under load. This makes them particularly valuable where the gasket is confined without relief. The absence of sideflow makes it easy to mate flanges.

Tolerances in the gauge of cork-and-rubber gaskets can be as wide as ±.015". This means that commercial tolerances for such materials are perfectly satisfactory for practically all applications.

Equally important—in some cases, more important—the compressibility of cork and rubber sometimes permits increases in the tolerances of the metal components, producing important savings in machining time.

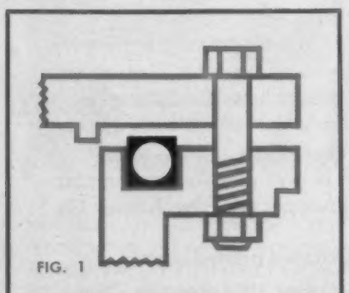


Figure 1. Note the relative sizes of a cork-and-rubber gasket and a comparable non-compressible molded ring. While the ring must be made to very close tolerances, cork-and-rubber's tolerance is not critical.

Figure 1 illustrates the relative sizes of a cork-and-rubber gasket and a comparable non-compressible molded ring. The resilient cork-and-rubber compound permits wide tolerance in its size. The molded ring, however, must be made to very close tolerances to allow perfect fit between the flanges.

Similarly, in figure 2, wide tolerance cork-and-rubber gaskets make an effective packing ring. Their true compressibility controls lateral flow and prevents build-up of radial pressure on the shaft.

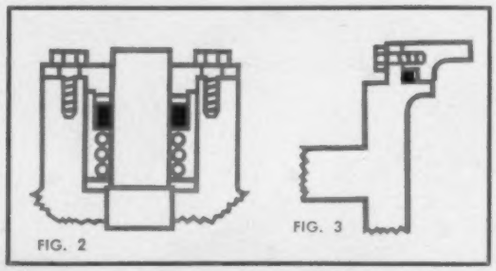


Figure 2. As a packing ring, cork-and-rubber does not build up excessive radial pressure on the shaft.

Figure 3. Cork-and-rubber gasket on flanged journal of calender roll.

When non-compressible rings were used on the flanged journal of the calender roll shown in figure 3, extremely close tolerances were required. Undersized rings leaked. Oversized rings prevented metal-to-metal contact between the flanges and caused misalignment. Both problems were solved with standard-tolerance cork-and-rubber rings, which fitted perfectly and sealed tightly.

There are fifteen different Armstrong cork-and-rubber materials available, including four sponged types. These compounds are made with nitrile-, styrene-, chloroprene-, or butyl-type synthetic rubber binders.

The chemical resistance of these compounds is comparable to that of the corresponding base polymers. Several Armstrong materials meet MIL-G-6183 and other specifications.

In density, Armstrong cork-and-rubbers range from soft, cork-like compounds to very firm compositions that are nearly as incompressible as straight rubber materials. All non-sponged compositions are impervious in their uncompressed state.

We also offer special-purpose compounds based on silicone and fluorocarbon polymers for use at temperatures 100° F. to 150° F. above the limit for presently available standard cork-and-rubbers. These special compounds have compressibility in the range of 15% to 25% at 400 psi.

A catalog describing all Armstrong materials will be sent on request. Detailed information on the selection, design, and performance of resilient gasket materials is contained in the Armstrong Gasket Design Manual. Write for your free copy today. Address Armstrong Cork Company, 7102 Ithaca Street, Lancaster, Penna.

Armstrong GASKET MATERIALS

IDEAS . . .
CONTROL SYSTEMS

Gas Supply Regulator Powered

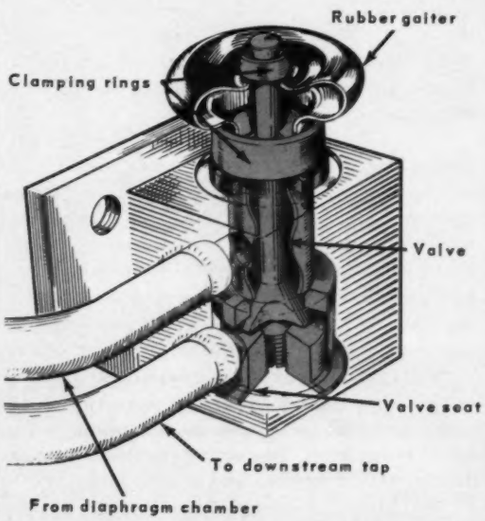
Ronald W. E. Martin, British Editor

A gas-furnace regulator derives power for its operation directly from the medium which it controls. The instrument is self-contained and self-operating except for the hand-wound spring motor driving the recorder chart. The system eliminates air or electrical supplies to simplify design and ease maintenance.

Basically, the arrangement comprises a diaphragm-operated relay valve in the main gas line, controlled by a pilot valve positioned mechanically by deviation linkage. Power for the relay valve is supplied by gas supply pressure, and power to operate the pilot valve comes from a bourdon tube of the temperature-measuring system.

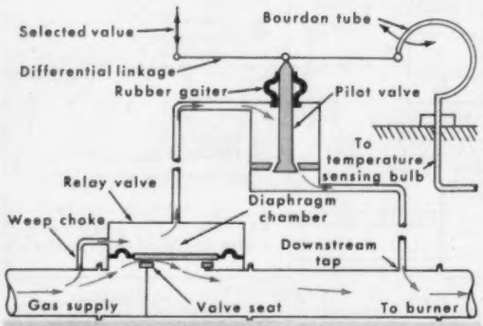
When the pilot valve is opened progressively, pressure in the diaphragm chamber is reduced. Relay valve opening therefore follows the opening of the pilot valve. Overall relationship between deviation and relay valve aperture is approximately linear over the working range.

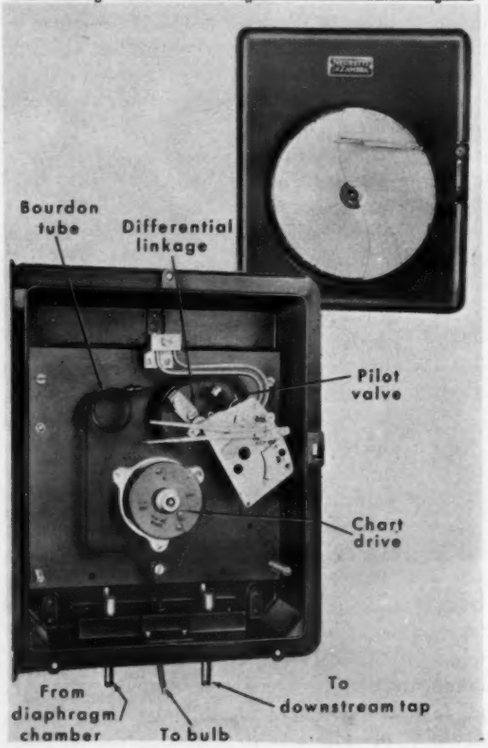
Designed by Negretti and Zambra Ltd., London, England, the self-operating regulator and recorder system is designated as "Gas-Stat".



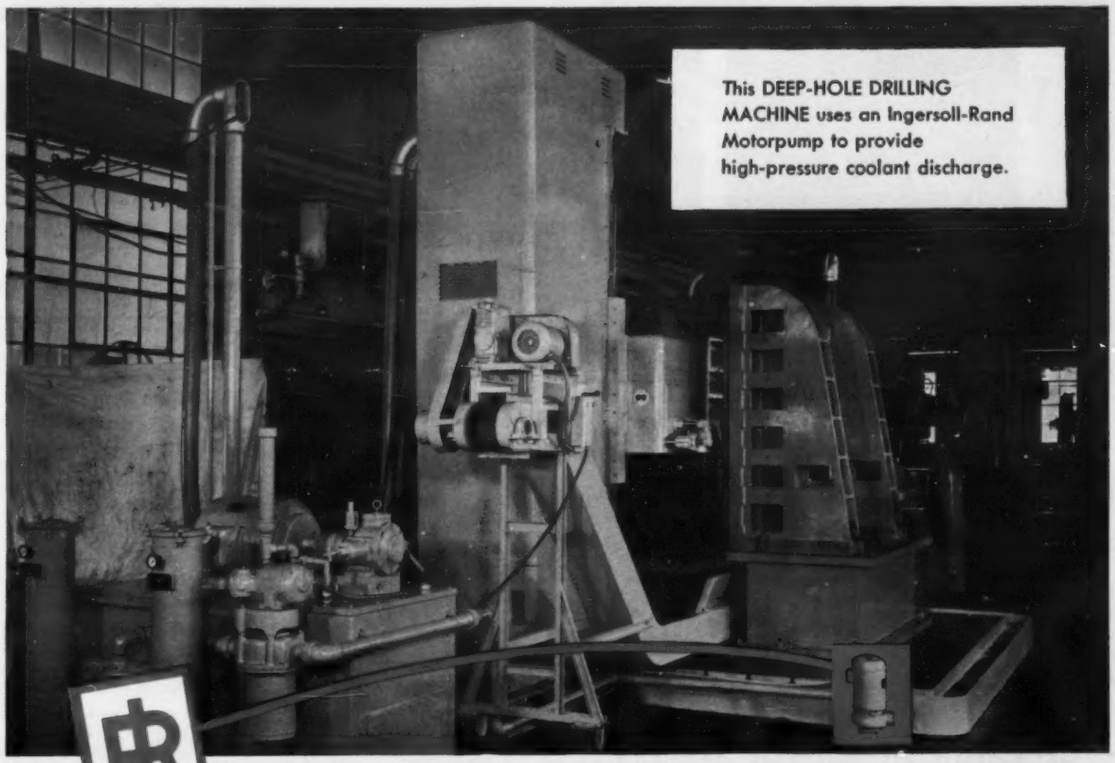
PILOT VALVE is sealed by gasproof synthetic rubber gaiter which also lightly loads valve in direction of its seating. Plastic (ptfe) conical valve operates on silver bronze seat in brass body. Use of cupronickel tubing connecting block reduces risk of corrosion products forming in tubing. Brass tubing is used between connecting block and instrument case unions.

by Pressure in Controlled Line





PILOT VALVE is operated by differential linkage system with bourdon tube on one side and manual temperature selector on other. At temperatures below desired setting, relay valve is open in proportion to pressures operating on either side of it, permitting gas flow to burners. With increasing temperature, bourdon tube slowly closes pilot valve, causing pressure build-up above relay valve. This closes slightly, reducing gas supply to burner. With decrease in temperature, bourdon tube opens pilot valve. This reduces pressure in diaphragm chamber faster than weep choke can supply. As a result, relay valve opens slightly (in proportion to extent of pilot valve opening) and burner receives increased gas supply.



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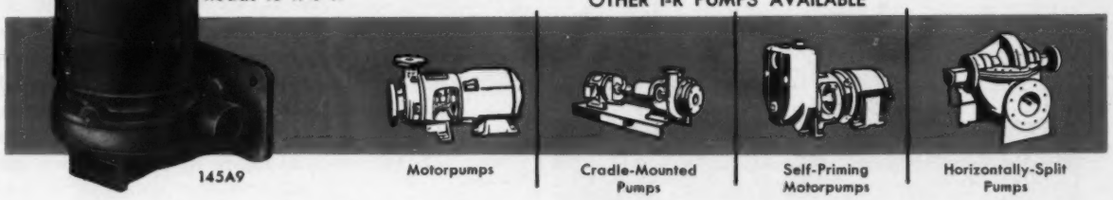

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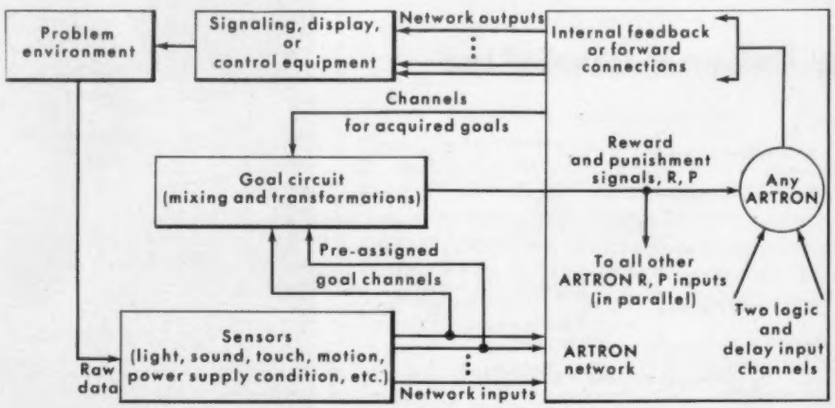
SCANNING PRESS RELEASES


Problem environment
Signaling, display, or control equipment
Network outputs
Internal feedback or forward connections
Channels for acquired goals
Reward and punishment signals, R, P
Goal circuit (mixing and transformations)
Any ARTRON
Pre-assigned goal channels
To all other ARTRON R, P inputs (in parallel)
Two logic and delay input channels
Sensors (light, sound, touch, motion, power supply condition, etc.)
ARTRON network
Raw data
Network inputs

• **PROPOSED ELECTRONIC NERVE CELL** will have the power to simulate elementary thought processes. Under a contract from the USAF, Melpar, Inc., will make a study of generalized machine learning, including fabrication of an artificial nerve cell that will learn as a result of reward and punishment signals. The contract also provides for digital computer simulation of a network of these nerve cells including self-generation of the reward and punishment signals.

The single cell, called ARTRON (for artificial neuron), will receive reward signals when it comes up with the right answer, punishment signals when it misses out, but it will be given enough play to experiment and try new approaches. Experience will teach it, in time, how to handle signals on the basis of its own "intelligence"—that is, the machine will make its own decisions.

Future development of the nerve network principle can be expected to result in "thinking machines" for more automatic weather prediction, unmanned vehicles for exploring the surfaces of planets and high-speed military gaming machines that can formulate their own strategy.

ARTRONS may be connected into networks as shown. Each ARTRON will have autonomously variable delay plus an autonomously variable logical capability encompassing 16 alternative Boolean gates for two-input logic. ARTRONS will provide a greater logical capability in terms of two inputs than other neuron models.

For learning, the logical gating and delay of the ARTRONS are selected by trial and error on the part of the machine; this initial variability of logic and delay progressively gives way to such consistency of action as is required. Collectively, a network of such variable-logic elements can lend themselves to a step-by-step progression of learning from simple to more involved problems through a tendency to build up logic interconnections.

Reward and punishment are a part of the learning process by which logic and delay are selected, depending upon the correlation of particular logic and delay values with successful or unsuccessful operation. For defining successful operation and supplying reward or punishment, the model utilizes generalized preassigned goal circuits and also may be designed to acquire goals autonomously. This could eliminate the need for any human operator and eliminate the need to anticipate problem contingencies.

Theory indicates that for uncomplicated problem environments, the ARTRON network will discover and supply solutions to a wide variety of problems within its total problem-solving capacity and may relearn if conditions change. Even one ARTRON can solve simple learning problems such as anticipating a cyclic binary series, and can illustrate purposive and creative behavior. The objective is to work toward extremely versatile machines that solve problems without being told how, machines capable of being organized by raw input data from the environment.

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custom made rupture units relieve overpressure — act as quick opening valve

Fike custom rupture units are ideal where space, weight or special installation problems are encountered. The rupture unit will relieve overpressure or act as a quick opening valve by rupturing precision made metal rupture discs at a predetermined pressure.

Units ⅜" to 1⅜" in diameter with ⅛" to 1" rupture discs are illustrated above. Depending on the application, rupture pressures of 200 to 10,000 PSIG are possible.

Other special assemblies can be provided for a specific requirement. We welcome inquiries on special and unusual applications.

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Blue Springs, Missouri

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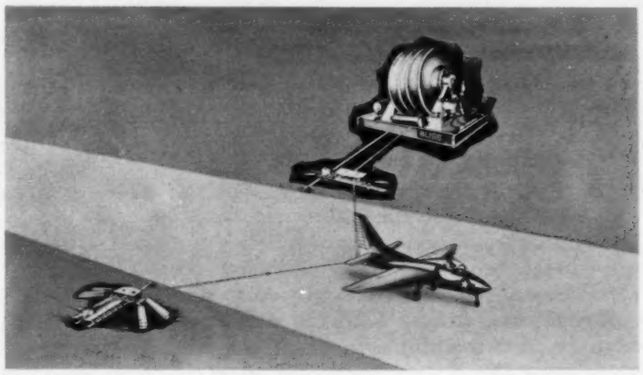
• **EMERGENCY OVERRUN BARRIERS** will stop safely any current jet fighter, traveling at 210 mph, within 1000 ft. The arresting unit consists of a braking engine installed underground alongside the runway with two reels containing strong, light nylon tapes. Tapes are drawn out over pulleys at each side of the runway and attached to an engagement cable stretched across the runway end.

When a pilot, on landing or during an aborted takeoff, discovers that he cannot stop his plane normally, he drops a specially installed hook, which catches the engagement cable. As the tape plays out, the aircraft is brought to a halt by a braking force automatically applied to stop the rotation of the tape reels.

The braking engine, a compact unit about 5 ft in dia, is capable of absorbing more than 33,000 hp within the required safety distance.

While the Air Force is now equipping all its newer jet fighters with arresting hooks, the arrestor can also be used with existing planes, which are engaged by their main landing gear rather than by a hook. The arrestor can be reset in less than three minutes by means of an electric rewind system.

One-hundred-and-ten overrun barriers will be built by the E. W. Bliss Co., Canton, Ohio, for the U. S. Air Force.



• **MEMORY-TYPE FAULT DETECTOR** offers greater reliability and versatility in the operation of complicated mill control systems. The new device features direct monitoring of the actual circuit or contact and indicates, with a memory function, any malfunctioning so that trouble-shooting is simple and direct.

The fault finder consists of a transistor-controlled rectifier, capacitor and neon light circuit with readily alterable time delay to prevent false indications in case of contact bounce in the circuit being monitored. The circuit is arranged so that any change in state beyond the time delay interval in the monitored circuit will trigger the controlled rectifier and turn on a high-intensity incandescent light. Later changes in the monitored circuit state will not affect the indicating light until it has been reset manually. The fault detector can monitor almost any circuit or device with complete isolation.

The detector is announced by Allis-Chalmers Mfg. Co. and is used in its heavy-duty main mill controls.

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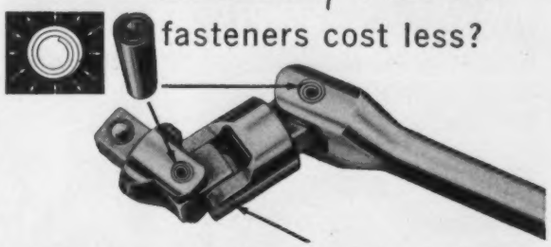
SPIROL *the true spring* **PIN**

fasteners cost less?



1. 80% of spring pin applications only require Medium Duty SPIROL PINS, which cost less.
2. Even the Heavy Duty SPIROL PINS in this socket-wrench universal joint don't cost more than other types of spring pins.
3. Assembly costs are lowered with SPIROL PINS! Just drill the hole (plus and minus tolerances allowed only by SPIROL PIN) and drive the pins—automatically or by hand.
4. Medium and Light Duty SPIROL PINS replace more costly fasteners, even in materials where other spring pins cannot be used. Come in Miniature Diameters, too: 1/32" to .052".

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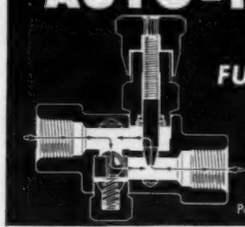
Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.



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MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

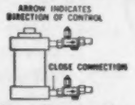
Model F Standard Flow Control Valve or Model N Needle Valve

Model KF Knob and Dial Flow Control Valve or Model NN Needle Valve.

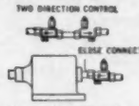
Model PF Knob and Dial Flow Control Valve or Model PN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Acting Cylinder



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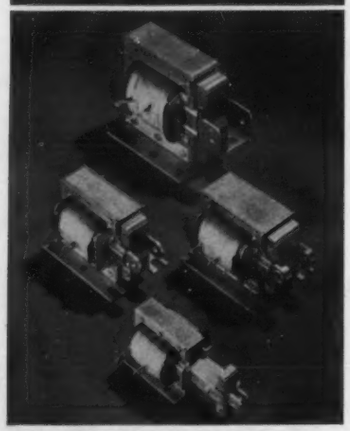

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- Heavier, Sturdier Mounting Brackets
- Extra Heavy, Well Supported Plunger
- High Seating Pull without excessive AC Hum
- High Dielectric Bakelite Bobbin
- Stainless Steel, Non-Rusting, Anti-Residual Spring
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- Stronger, Heavy Gauge, Pull-Bar
- Moisture Resistant Coil
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More rugged, with greater designed-in and built-in dependability, the new Super-T deserves to be called "America's Finest Solenoid Line". Write for Catalog today!

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RELEASES...

• **"TRANSTAINER"**, equipped with pneumatic rubber tires, transfers piggyback cargo carriers from trucks to rail cars. It can travel down a train, loading and unloading as it goes, without losing time to back off or make trips the length of the train to move and deposit the cargo.

The TransTainer, standing 24 ft high with a 21-ft wheel base, can stack containers two units high to save space. The four special tires, supplied by B. F. Goodrich Tire Co., are size 18.00-25 with 28-ply rating. They support the mobile gantry crane and its cargo weighing up to 70,000 lb. Tire inflation pressure is 110 psi.

The handling device is produced by Pacific Coast Engineering Co.

• **LIQUID ELECTRODE** for use in eye surgery has been developed at the University of California. The instrument is composed of a glass tube containing saline solution and an electrolytically coated silver wire. Treatment current is transmitted through the silver wire and saline solution to the tissues of the eye. A fluid reservoir maintains a uniform contact pressure and provides replacement of liquid lost through evaporation.

Experimental studies have indicated this new type of electrocoagulation equipment may be applied effectively and safely to treatment of retinal detachment and certain types of glaucoma.

Primary advantage of the liquid electrode over the standard metal electrode is the optimum and uniform contact with eye tissue that is established and maintained. This optimum contact permits careful control of the electrical current used for treatment and makes possible accurate measurement of electrical properties of treated tissues. Alterations in treated tissues can then be used as a guide to the effectiveness of treatment.

• **AMPHIBIOUS MILITARY VEHICLE** is designed to give ground forces high mobility in all types of terrain. The lightweight, six-by-six vehicle is articulated to provide uniform loading on all wheels.

Rear body of the vehicle can be detached from the front body, enabling the loaded rear to be delivered to its destination and a new one substituted. The rear is adaptable as a troop carrier, missile transport and cargo carrier.

Power for the vehicle is provided by an air-cooled automotive engine. It has four forward transmission speeds, will do up to 50 miles an hour and has a range of 1000 miles. Weight is 3100 lb empty.

The "Gama Goat" was invented by Rodger L. Gamaunt, Fawnskin, Calif., and developed, built and tested by Chance Vought.

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Series 190

FLOW REGULATORS

Constant Speed Operation
regardless of load!

At a cost comparable to an ordinary restrictor or needle valve, you can have pressure-compensated flow control in your hydraulic circuits.

Rated for pressures to 3000 p.s.i.

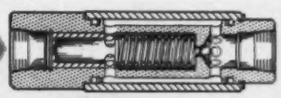
Wide range of sizes available—¼" to 1½" N.P.T.F. and ¼" to 1" S.A.E. tube.

Flows to 100 g.p.m. can be controlled.

Factory-calibrated and tested to ±10% tolerance. Closer tolerance available.

Require little more space than pipe or tube in which installed.

Trouble-free in operation—tens of thousands in use.



Unit senses pressure drop across precise orifice and reacts to control flow with desired limits.

Send today for new Catalog 1002.

W-6105

WATERMAN

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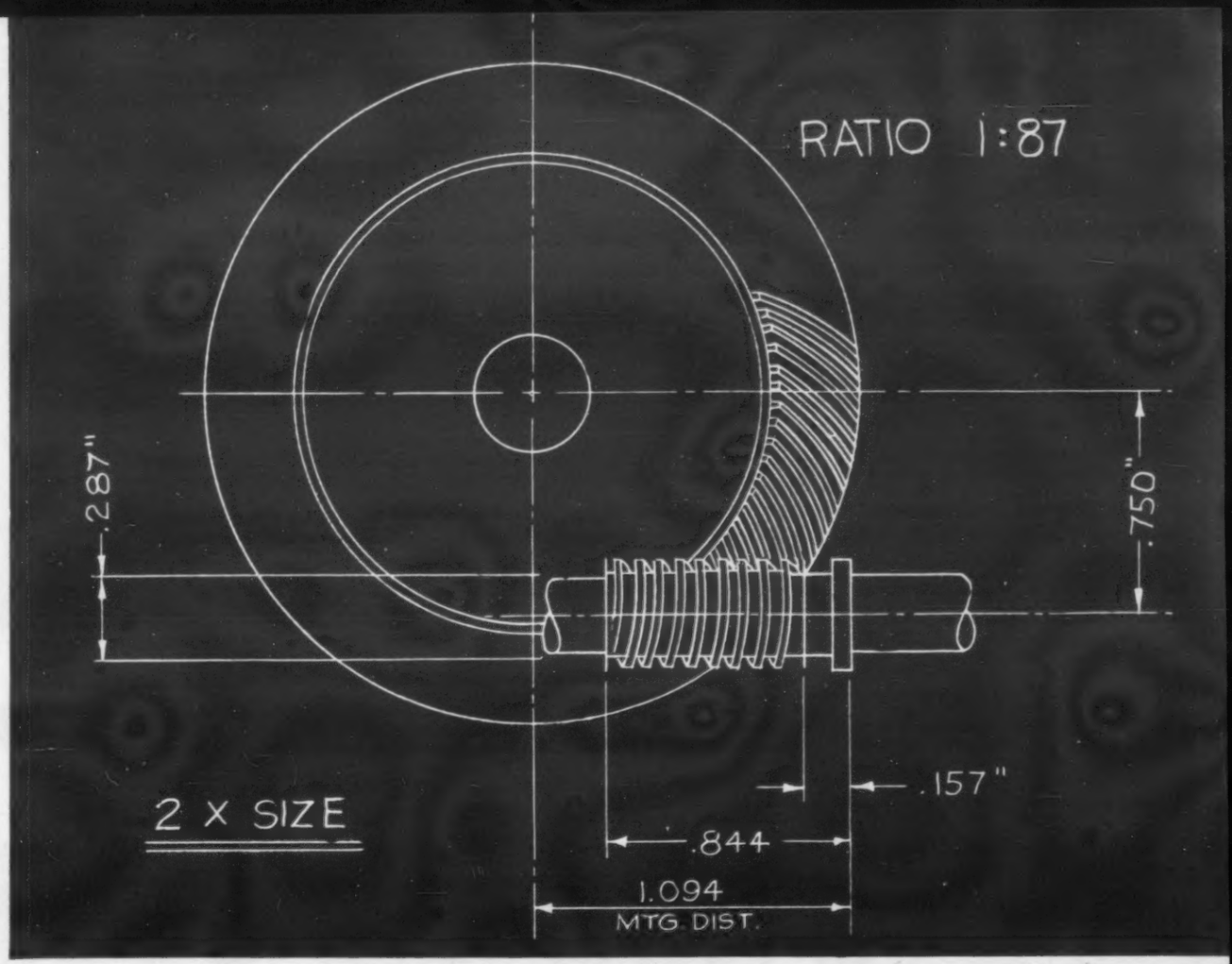
• **FIRST PHASE** of a two-million dollar modification program is under way at the Douglas Aircraft Co.'s Sacramento field station in preparation for system and static testing of the Saturn S-IV and future space vehicles. Major items in the modification program include the installation of a liquid hydrogen storage and transfer system and the altering and enlargement of two missile test stands for cold-flow testing and static firings. The test stands were used previously for static firings during the Thor IRBM development program.

A static test "vehicle" will be installed in test stand No. 1 and will be used initially to simulate the physical characteristics of the S-IV during the cold-flow (propellant transfer) test program. During the latter part of next year, four high-energy, liquid hydrogen-liquid oxygen LR-119 engines will be mounted in the static unit for a series of advanced engine tests. Four of these Pratt & Whitney engines, each generating 17,500 lb of thrust, will propel the S-IV on its space flight.

Test stand 2B will be modified to accept a production model of the S-IV for a comprehensive and highly instrumented program of static firings and all-systems testing. During the static firings, steam-evacuated altitude simulators will create an "outer space" condition of near-vacuum around the engine nozzles. This condition will approach the environment existing at the altitudes at which the S-IV engines will be ignited during actual flight.

Two 35-ft-dia spherical tanks will be installed at the field station for the storage of liquid hydrogen. Capacity of the tanks will be 90,000 gal each.

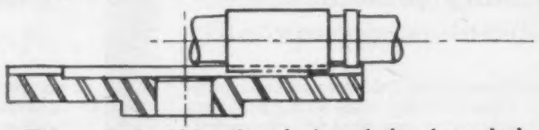
Other projects at the field station will include the construction of a steam plant for operation of the altitude simulators and addition of a 14,000-gal liquid oxygen tank.



HERE'S ANOTHER GEAR GLEASON BUILT FROM FIRST DESIGN TO FINAL PRODUCT

This is the finished prototype of a new high-ratio hypoid gear. Our customer will now produce it, royalty free, on his Gleason equipment.

This is but one example of what Gleason engineering service can do for people who need gears. Our facilities and advice are at your constant disposal for development of bevel and hypoid gears to meet the needs of any application.



This particular high-ratio pair (actual size shown in insert) offers several advantages over conventional gears:

GREATER STRENGTH. High-ratio hypoid pinions are larger and stronger than corresponding bevel pinions.

COMPACTNESS. Where space is a problem, the high-offset principle lets you design a more compact and flexible unit than the corresponding worm and wheel.

SMOOTHER ACTION. High-offset pairs provide smooth, quiet tooth action . . . *continuous* action even with only one or two teeth, because of the way the teeth wrap around the pinion.

STRADDLE MOUNTINGS. Cylindrical high-ratio pinions, with extended shank, make practical very rigid straddle mountings.

GRINDING. High reduction hypoids are cut on same Gleason equipment used on familiar bevel and hypoid gears. Same testers, quenchers and other auxiliary equipment can be used. Grinders are available for the ultimate in precision and finish to minimize friction.

LET GLEASON MAKE RECOMMENDATIONS. Send along a set of prints, and we'll be glad to study them and give you our thoughts on how best to make the gears you need.

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

Circle 94 on Reader-Service Card

• PUSH-BUTTON COMMUNICATIONS DEVICE enables a jet pilot to "talk" to his base with greater speed and more accuracy. Called "Digikey" by its inventors, the device permits the pilot to talk through heavy electrical interference at a rate of 150 words per minute (twice normal speed) by punching keys on a small semi-automatic keyboard.

Digikey converts a message into digital form and transmits through a communications system to a ground station where the digits are reconverted into words and displayed in printed form on a receiver unit. A belt or roll chart, on which message words are printed, covers the keyboard with words directly over the keys. The operator is, in effect, given a "multiple choice" and selects a word from the first group displayed and punches that key, registering the word in the system's memory. The belt advances to a new set of words and another message is selected. At the same time, other information from the aircraft's instruments is being recorded in the memory. On completing the message the operator presses a "transmit" button and the message is broadcast automatically as many times as desired.

The difficulty of communicating through heavy electrical interference is overcome by breaking up the message into a series of coded electrical pulses which are transmitted over several frequencies. Only a few pulses need to get through for the receiver to recognize the character transmitted.

Information from a large number of aircraft can be fed directly into automatic command and control systems for data processing because there is no need to translate the digits into computer language.

The Digikey communications device was disclosed by Hughes Aircraft Co.

• AIRPORT RUNWAY INSTALLATION to assure greater takeoff and landing safety for large commercial jet transports has been proposed by the Nortronics Div. of Northrop Corp. The system, called "Decel", consists of a shallow water-filled basin with a strong, flexible cover and is installed at the windward end of a runway. Jet aircraft that would otherwise overrun the runway during landing or aborted takeoff roll into the Decel basin. The continual process of depressing the flexible cover and displacing a large volume of water slows the aircraft to a safe stop.

A preliminary computer analysis of the Decel concept using specifications for the DC-8, 707 and 600 model jet transports has been conducted by Nortronics. Results indicate that at an entry speed of 75 knots, a Decel basin, 600 to 700 ft long, would effectivelv stop a jet transport without reverse thrust, without brakes and without damage.

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MR. CONTROLS

Control Components

Exemplary products for original equipment

Robertshaw bellows, "packaged" bellows and other control components solve many design engineering problems in harnessing temperature, pressure and movement. These assemblies are custom-designed. Whether the need is for a few dozen or many thousands, Robertshaw gives personal service and on-time deliveries.

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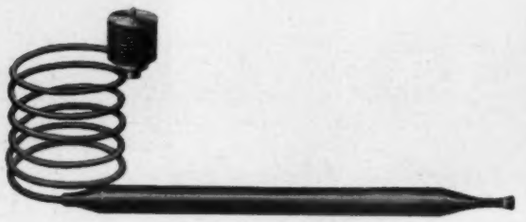

Temperature Sensors

Accurate, no-drift control for appliances

Robertshaw low-cost "packaged" bellows and Diastat® short-stroke assemblies for heat and cold control of refrigerators, ranges, skillets and other large and small appliances are completely assembled . . . custom-designed for fast, money-saving installation . . . are consistently calibrated . . . don't need resetting . . . don't need compensating devices for most applications . . . and give service that wins user recommendations for the appliance maker. Ask for Bulletins BT 436 and 60.

• **ELECTRONIC IMAGING TUBE,** placed on a vehicle in space, will enable scientists to learn more about the stars and the depths of interstellar space. The tube is sensitive to short wave-length ultraviolet light rays that are emitted by celestial bodies but never reach the surface of the earth since they are screened by the atmosphere.

Called the Uvicon, the tube was developed by Westinghouse Research Labs. for the Astrophysical Observatory of the Smithsonian Institution, Cambridge, Mass. The tube will be used in the Observatory's Project Celescope.

The Uvicon is an extremely sensitive image tube operating in the range from 1200 to 2000 Angstroms. It is about 2 inches in dia, 12 inches long and weighs about 8 oz. In operation, the Uvicon receives an ultraviolet image through a special window, made of lithium fluoride, mounted at the input end of the tube. The back surface of the window is coated with a photo-emitting material that releases electrons when the ultraviolet image strikes it. These electrons are accelerated by 15,000v toward the rear end of the tube, where they strike a thin film or target.

The impact of the electrons on the target causes it to take on an amplified electrical charge in the exact pattern of the ultraviolet image. The next step is to read off this charge as an electrical signal and thus reproduce the image electrically. This is done by scanning the rear surface of the target with a beam of electrons, much as an electron beam scans the viewing end of a television picture tube. In the Uvicon, however, the product of the scanning is an electrical "image" that can be amplified and broadcast rather than a visual image that can be seen directly. The overall technique is known as electron-bombardment-induced conductivity.

Project Celescope's electronic telescope system consists of three components: an optical arrangement to form the ultraviolet images; a Uvicon pick-up tube and its associated circuitry, which constitute a TV camera that responds to the ultraviolet images and converts them into electrical signals, and a transmitter to broadcast these signals back down to earth.

The ultraviolet telescope package will go into the nose cone of an Aerobee-Hi rocket, which will take it to an altitude of about 150 miles. The useful portion of the flight will be the five minutes spent above an altitude of 60 miles, which is the height at which the ultraviolet radiations of interest cease to be absorbed. At this height the protective front portion of the nose cone will be jettisoned and the telescope exposed to the skies.

Information on brightness of stars will be telemetered to electronic storage equipment on the ground for final analysis of stellar magnitudes. In addition, the presence of sources of ultraviolet radiation in interstellar space will be recorded.

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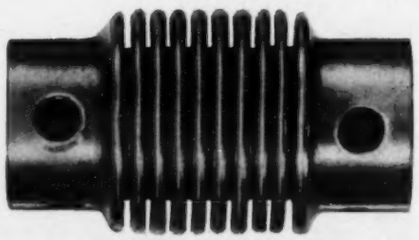

Flexible Couplings

Eliminate backlash, end-play; absorb vibration and shock

Servomechanisms, instruments and similar drive and control systems are the big users of these small units. Robertshaw flexible couplings are ideal for guarding against misalignment, friction and bearing wear problems. Save space and weight. Simplified design utilizes seamless metallic bellows, in choice of several metals, connected to two hubs. Stock sizes accommodate shafts from 1/8" to 1/2". Other sizes custom-engineered. Write for Bulletin 80.

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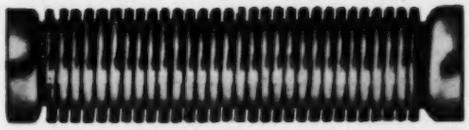
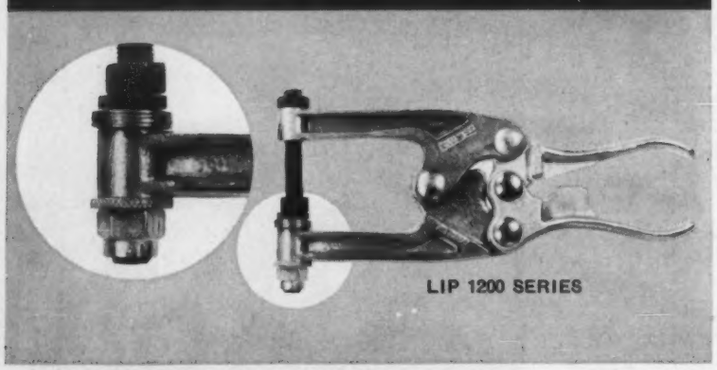


Miniature Bellows

Save space and weight with these rugged metallic bellows

Robertshaw precision-made seamless bellows, as small as 1/8" O.D., do a big job of miniaturizing aircraft and missile instruments and other equipment. Used in long-lived temperature and pressure sensors or compensators, and as positive permanent seals. Available in a wide range of bellows metals, lengths and terminations. Custom-engineered and supplied in any quantity by the pace setting producer of metallic bellows for industry. Write for Bulletin BT 436.

NEW *KNU-VISE* LOAD INDICATING PLIERS GUARANTEE CLAMPING FORCE



These pliers are for applications where it is essential, and often critically so, that a certain clamping force be applied time after time—*regardless of the thickness of the work.*

In use, the adjusting spindle is set for the desired clamping force by trial clamping. When the proper force is obtained, the self-locking nut on the anvil is then adjusted so that the LOAD INDICATING WASHER moves "just smoothly" with the plier clamped on the work. Thus, once a certain clamping force has been established it can be readily duplicated on any other work thickness simply by adjusting the spindle so that the LOAD INDICATING WASHER again moves "just smoothly" after clamping.

Write for complete information on this time-saving model.

Manufacturers of over 150 models of manually and air-operated clamps and pliers

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Solar Search

Ancient Egyptian and Chinese inscriptions are being studied by modern day scientists to learn more about the sun's activities. Together with modern scientific methods, scientists are trying to determine the sun's activities during the last 1700 years.

Sunspot and "Northern Lights" observations in Asia, north Africa and Europe, as far back as 220 B.C., have been used, according to D. Justin Schove of St. David's College, Kent, England.

These observations are depicted, for example, on dated paintings by the medieval Chinese.

From this material, periods of strong and weak solar activity have been determined, and changes in the length of the well-known 11-year solar cycle have been found. The great famines and droughts recorded by the Islamic people in Asia reflect the effect of the solar cycle on the climate.

Modern scientific methods will supplement the studies of ancient records, the scientist said. Radiocarbon dating of tree rings and clay varves on lake bottoms will permit scientists to determine solar cycles even before 220 B. C.

Just Ask a Camel

The amount of water available to a thirsty population living in hot, dry climates can be measured by determining the water's age.

Carbon-14 dating of underground water supplies tapped by wells tells scientists how much water can be removed safely without exhausting the supply, according to K. O. Munnich II of the Physikalisches Institut der Universitaet, Heidelberg, Germany.

If the water is young in age, much rain water must be continually seeping into the ground and replenishing the water supply. Older or "fossil" water indicates that the water supply will be depleted quickly because no water in recent years has penetrated.

Foggy, Foggy Dew

A solution to the problem of how to dispel the dangerous soupy fog which rolls in across airport runways has been offered by Roberto Giannoni of Florence, Italy. The system clears the air by freezing the tiny droplets.

A network of pipes underneath the runway connects to a refrigeration unit. The foggy air is drawn in through pipe openings, spaced a few yards apart, and compressed. It is then sent through boxes immersed in a freezing alcohol solution, where the foggy droplets freeze to the box walls. The compressed air is rerouted to another pipe system and sent back to mix with the outer air.

Ah, Ah—Your hands clean?

IN BRIEF

• **CONTINUED PRODUCTION OF AIRCRAFT VULCAN GUNS,** a General Electric product, has been authorized by U. S. Army's Boston Ordnance District. The 20 mm M61, firing 6000 rounds per minute, is used by both United States and foreign air forces on such supersonic aircraft as F-104 Starfighter, F-105 Thunderchief and B-58 Hustler.

• **BALLISTIC MISSILE EARLY WARNING** site at Thule, Greenland, requires millions of watts of power—enough to light a city of 30,000 people. Power is supplied by a U. S. Navy generator ship.

• **NADC** pilot in his supersonic interceptor is not alone in his ability to create a sonic boom. Nearly anyone can pull off at least a sonic pop—merely by cracking a whip. The loud noise produced by a snapping whip results from its breaking the sound barrier. When the swishing whip reaches a point at which it is traveling faster than sound, it creates a loud snap or pop.

• **WHAT'S MACH?** Named after Austrian Physicist Ernst Mach (1838-1916), it is a unit of speed measurement for a moving object equal to the speed of sound in the medium in which the object moves. Thus, Mach 0.5 is a speed equal to one-half the speed of sound in the medium, and Mach 1 is a speed equal to that of sound.

• **SONIC BOOM** is an explosion-like sound heard when a shock wave generated by an aircraft flying at supersonic speed reaches the ear.

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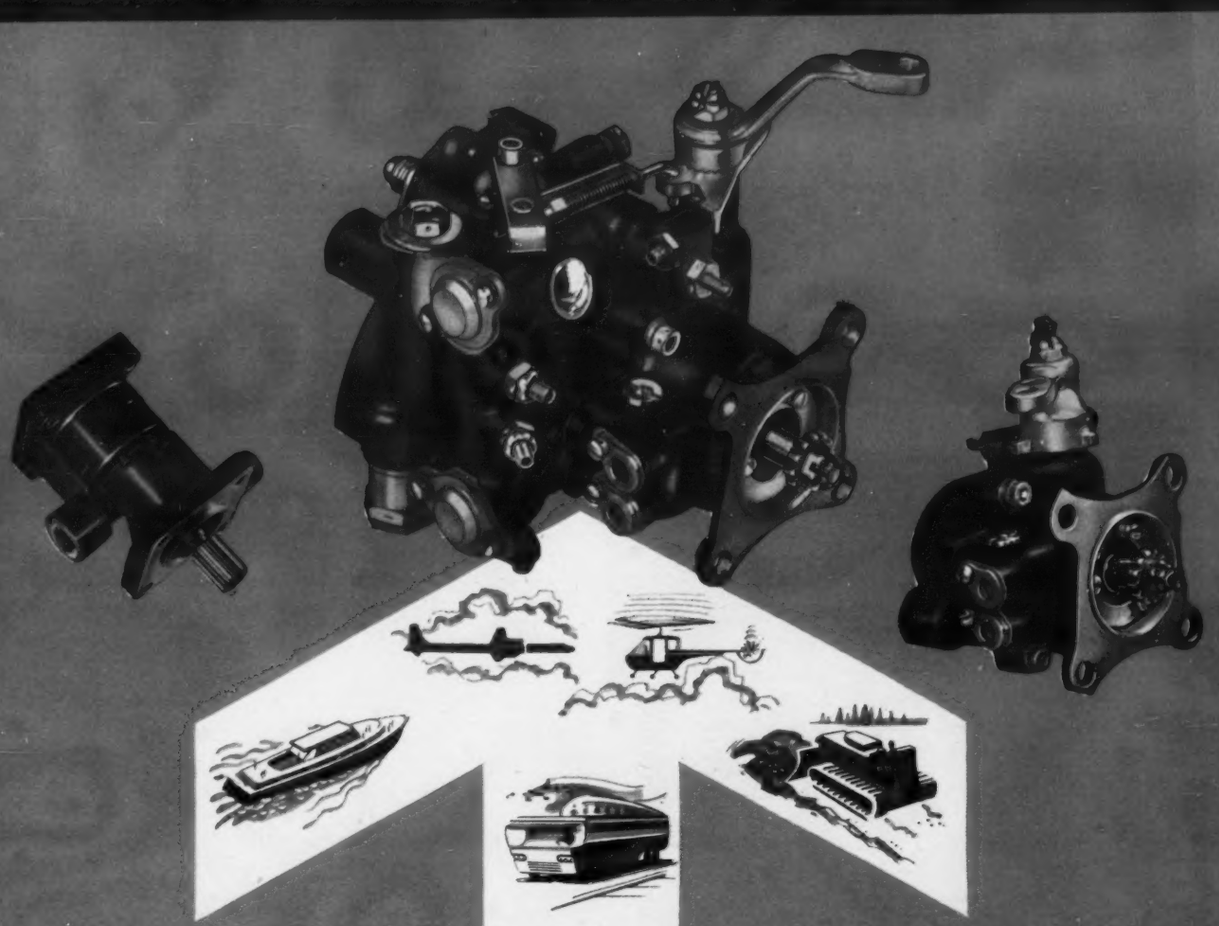

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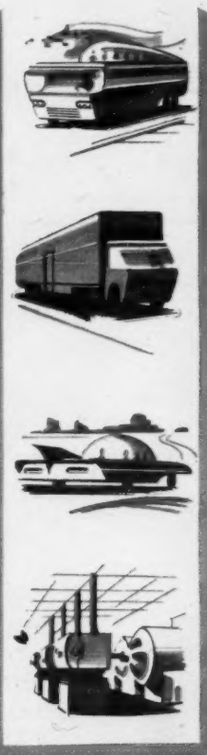
SAVE WEIGHT, SPACE AND COST



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Through Bendix design flexibility and production experience, systems can be tailored to meet varied requirements. The small size, low weight and simplicity of the components assure a low-cost system.

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IN BRIEF...

• **MORE KNOWLEDGE OF IONOSPHERE** is the goal of a forthcoming scientific experiment to be launched on a Juno II by NASA from Cape Canaveral. Several universities in the United States and New Zealand are participating in this experiment, intending to find out more about the shape of the ionosphere—where there are concentrations of electrons, where the ionosphere's profile has peaks or valleys in its structure. The payload being prepared for orbit is called the Ionosphere Beacon Satellite S-45. It looks very much like Explorer VII and Explorer VIII, two truncated cones back to back. The S-45, however, has a 6-ft loop antenna around its equator to transmit its low-frequency signals to ground stations.

• **TOOTH-SIZED MICROCIRCUITRY TRANSMITTER,** so compact that the entire unit including its battery is mounted as a tooth in a dental bridge, was shown publicly at the American Astronautical Society Seventh Annual Meeting. The tiny aid to vital aerospace medical research was developed by Varo, Inc., Garland, Tex., and is being used by the USAF Aerospace Medical Center at Brooks AFB. Scientists are monitoring the number of closures, grinding and tooth pressures as a measure of the amount of stress being experienced by the person under test. The transmitter is immediately switched on when upper and lower teeth are brought together; when the teeth are separated, the transmitter signal is stopped.

• **ORBITING ASTRONOMICAL OBSERVATORIES** are scheduled for launching in 1963. The satellite is expected to weigh about 3500 lb and to be placed by an Atlas-Agena B launch vehicle in a 550-mile nearly circular orbit. The principal experiments in the first observatory relate to the emission and absorption characteristics of the stars and nebulae in the ultraviolet.

• **WHAT WOULD YOU DO** if a bomber carrying a nuclear weapon crashed in your city? Challenging some speed track records would not be an uncommon reaction—and that's about what some people from Hamilton Air Force Base, Calif., and the nearby city of Novato did recently in a nuclear accident exercise. They sped toward the scene of the "crash", rather than away from it, however.

• **SONIC SPEED.** When an object travels in air or other medium at the same speed as that of sound in the same medium, it has reached *sonic* speed; *supersonic* refers to the speed of an object moving at a speed greater than that of sound; *hypersonic* pertains to speeds faster than Mach 5, or five times or more the speed of sound.

Meetings

Los Angeles, Calif. Feb. 27-Mar. 1	WESTERN MEETING, Association of Iron and Steel Engineers, Hotel Statler.
Pittsburgh, Pa. Mar. 2-4	SPRING MEETING, Optical Society of America, Pick-Roosevelt Hotel.
Washington, D. C. Mar. 5-9	CONFERENCE AND EXHIBIT of Gas Turbine Power, American Society of Mechanical Engineers, Shoreham Hotel.
Washington, D. C. Mar. 5-10	CONVENTION, American Congress on Surveying and Mapping, and American Society of Photogrammetry, Shoreham Hotel.
Buffalo, N. Y. Mar. 13-17	ANNUAL CONFERENCE, National Association of Corrosion Engineers, Statler Hotel.
Detroit, Mich. Mar. 14-16	NATIONAL AUTOMOBILE MEETING, Society of Automotive Engineers, Sheraton-Cadillac Hotel.
Dayton, Ohio Mar. 16-18	ANNUAL CONVENTION, Ohio Society of Professional Engineers, Biltmore Hotel.
Cincinnati, Ohio Mar. 20-22	NATIONAL PRODUCTION MEETING, Society of Automotive Engineers, Netherland Hilton Hotel.

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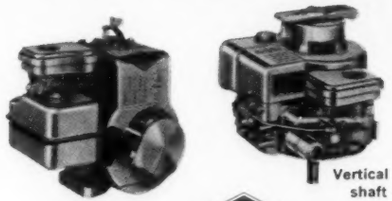

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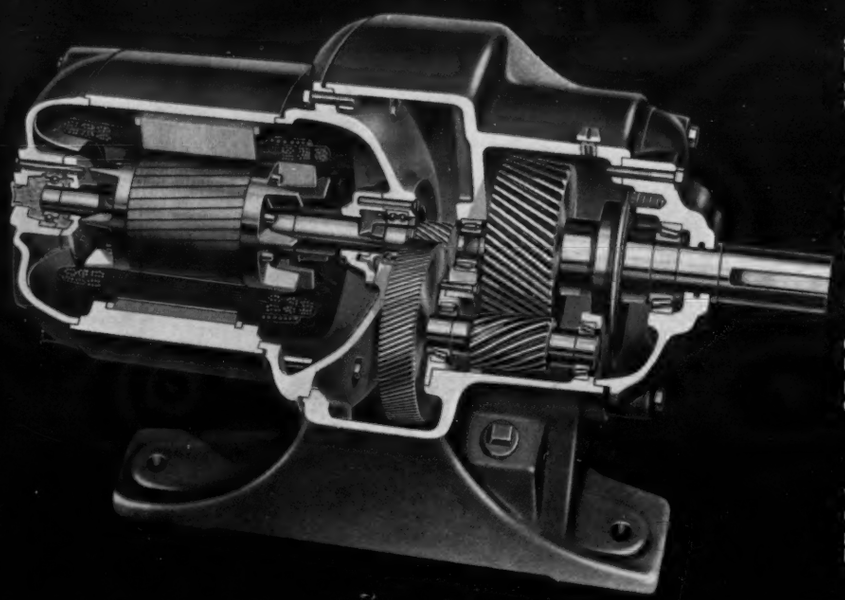

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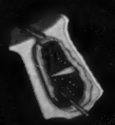

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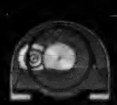

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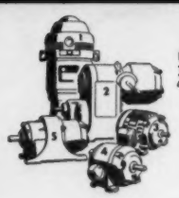

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